ONLINE BLOOD BANKING SYSTEM

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UNIVERSITI UTARA MALAYSIA

2010

ONLINE BLOOD BANKING SYSTEM

A thesis submitted to the Graduate School in partial fulfillment of the requirements for the degree Master of Science (Information Technology)

Universiti Utara Malaysia

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ABSTRACT

The importance of blood in the existence of human cannot be over emphasized. It supplies all nutrients and oxygen into the inner part of their body and body cells, and it has been medically proven that no one can survive without the presence of blood. Lack of access to blood has caused great havoc in the medical practice. The issue of blood bank, such as the way how the donated bloods are kept and how to access the blood are very critical for every hospital. In some cases the patient cannot get the blood at the right time due to the fact that the branches are not internetworked. Therefore, online blood banking is expected to solve the problem of inadequacy of blood when required for medical purposes. A prototype will be developed using the general design methodology.

DEDICATION

I dedicate this humble work to my father and mother; the spring of loyalty, affection, and dedication. They raised me on the principles of virtue; to my dear brothers and sisters who spared no effort in helping me during my school years.

I am also expressing my heartfelt thanks to all my colleagues and friends at UUM, especially from the Department of Applied Science, College of Arts and Sciences for their help and support, with whom I shared pleasant times. My thanks and gratitude goes to my friends Mose, Shaaban, Ahmed, Kerri, Tareq, Abdul Rahim, Ardis, Massoud, Ali, Hedia, Abd Allah and all my family members for their encouragement and support throughout the period of my study.

ACKNOWLEDGEMENT

Praise is to ALLAH for helping me to accomplish this humble study. Also, my thanks to ALLAH who has seen me through to this level in my academic achievement, I would like to seize this opportunity to extend my gratitude to my Supervisor Zhamri Che Ani for kindly supervising this study, her priceless instruction and valuable directions has had great role in the accomplishment of this report and my evaluator Mr. Shahrudin for his suggestions and help.

I would like also to thank all my instructors in the College of Arts and Sciences in the University Utara Malaysia (UUM) for their support.

Thank you UUM

Ali Ahmed Barka

8th May, 2010

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1. Introduction 1

1.2. Problem Statement.....3

1.3. Research Questions.....4

1.4. Objectives of the Study.....4

1.5. Significance of the study.....4

1.6. Scope of The Study.....5

1.7. Organization of The Report.....6

1.8. Summary.....6

CHAPTER 2

LITERATURE REVIEW

2.1. Introduction 7

2.2. Definition of Blood Banking.....7

2.2.1.Types of Blood.....8

2.2.2. The Process of Blood Donation.....8

2.2.3. Online Blood Banking System: Issues and Challenges 10

2.3. Web Applications Enabling Technologies.....17

2.3.1. Linux, Apache, MySQL and PHP (LAMP).....18

2.4. Summary 21

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction.....22

3.2 Research Methodology.....22

3.2.1 Awareness of Problem.....23

3.2. 2 Suggestion.....23

3.2.3 Development.....24

3.2.4 Evaluation 25

3.2.5 Conclusion.....26

3.3 Cycle of RUP.....26

3.3.1 Business Modeling 27

3.3.2 Requirements 28

3.3.3 Analysis and Design.....30

3.3.4 Implementation 31

3.3.5 Usability Testing 31

3.3.6 Deployment 32

3.4 Summary 32

CHAPTER 4

THE DESIGN OF ONLINE BLOOD BANKING SYSTEM

4.1 Introduction.....33

4.2 Result of Interview.....33

4.3 List of Requirement 34

4.3.1 Functional Requirement.....34

4.3.2 Non Functional Requirement.....36

4.4 Use Case Diagram.....38

4.5 Use Case Specification.....39

4.6 Sequence Diagram.....45

4.6.1 Login 45

4.6.2 View Information.....46

4.6.3 Demand Page.....47

4.6.4 Update Information Branch 48

4.6.5 Manage System.....49

4.6.6 View Report.....50

4.7 Class Diagram.....51

4.8 System Architecture.....52

4.9 OBBS Interface Design 53

4.9.1 Login Page 53

4.9.2 Page of Add Branch 54

4.9.3 Page of Delete Branch 55

4.9.4 Page of Update Branch Information 55

4.9.5 Page of View Information 56

4.9.6 Page of Blood Demand 57

4.9.6 Page of View Report.....58

4.10 Summary.....59

CHAPTER 5

RESULT DISCUSSION

5.1 Introduction 60

5.2 System Evaluation 60

5.3 Evaluation Techniques 61

5.3.1 Constraints and Purpose.....61

5.4 Testing and Results.....61

5.5 Reliability Analysis Test 62

5.6 Summary 67

CHAPTER 6

CONCLUSION

6.1 Introduction.....68

6.2 Problems and Limitations.....68

6.3 Future Development Considerations 69

6.4 Conclusion.....70

REFERENCE.....71

APPENDIX A 76

APPENDIX B.....77

LIST OF FIGURES

NO		PAGE
1.1	Example of Blood Bank	2
2.1	Blood Donation at a Blood Centre	10
2.2	Java Web Application Request Handling	20
3.1	Research Design Methodology	23
3.2	The Prototyping Processes	24
3.3	Rational Unified Process	27
4.1	Use Case Diagram	38
4.2	Login Use Case Specification	39
4.3	View Information Use Case Specification	40
4.4	Blood Demand Use Case Specification	41
4.5	Update Branch Information Use Case Specification	42
4.6	Manage System Use Case Specification	43
4.7	View Report Use Case Specification	44
4.8	Sequence Diagram For Log-In	45
4.9	Sequence Diagram for View Information	46
4.10	Sequence Diagram for Blood Demand	47
4.11	Sequence Diagram for Update Branch Info	48
4.12	Sequence Diagram for Manage System	49
4.13	Sequence Diagram for View Report	50
4.14	Class Diagram	51
4.15	System Architecture	52
4.16	Login Page	53
4.17	Page of Add New Branch	54
4.18	Page of Delete Branch	55
4.19	Page of Update Branch Information	55
4.20a	Page of View Information Used by Branch	56
4.20b	Page of View Information Used by Center	56
4.21a	Page of Blood Demand	57
4.21b	Page of Blood Demand	57

4.21c	Page of Blood Demand	58
4.22a	Page of View Report Used by Branch	58
4.22b	Page of View Report Used by Center	59
5.1	Interactive Graph for the First Question	64
5.2	Interactive Graph for the Eighth Question	65
5.3	Interactive Graph for the Eleventh Question	66

LIST OF TABLES

NO		PAGE
3.1	Likert Scale Classification	26
3.2	System Functions	30
4.1	Functional Requirements	35
4.2	NON Functional Requirements	36
5.1	Results of Reliability Test	62
5.2	Descriptive Statistics	63
5.3	Frequency Statistics for the First Question	64
5.4	Frequency Statistics for the Eighth Question	65
5.5	Frequency Statistics for the Eleventh Question	66

LIST OF ABBREVIATIONS

ACID	Atomicity, Consistency, Isolation and Durability
AIM	Appropriate Inventory Management
AABB	American Association of Blood Banks
API	Application Programming Interfaces
ASP	Active Server Pages
CGI	Common Gateway Interface
DB	Data Base
DBMS	Data Base Management System
OBBS	Online Blood Banking System
GUI	Graphical User Interface
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
IBM	International Business Machines
J2EE	Java 2 Platform Enterprise Edition
JSP	Java Server Pages
JWSDP	Java Web Services Development Pack
LAN	Local Area Network
LAMP	Linux, Apache, MySQL and PHP
PHP	Personal Home Page
RUP	Rational Unified Process
SAD	Systems Analysis and Design
SSL	Secure Sockets Layer

SQL	Structured Query Language
WAE	Web Application Extension
UML	Unified Modeling Language
UUM	Universiti Utara Malaysia
XML	eXtensible Markup Language
QSEs	Quality System Essentials

CHAPTER 1

INTRODUCTION

1.1 Introduction

The blood is a specialized bodily fluid that delivers necessary substances to the body's cells - such as nutrients and oxygen. Modern medical care, including surgery and medical treatment for many diseases, is not possible without the use of blood products. A shortage of blood products means that someone may not get prompt, adequate care for those undergoing major surgery, and for those with other causes, of blood loss. Blood transfusions also are used to treat severe anemia resulting from other causes as well, including the effects of chemotherapy, cancer, sickle cell disease, and thalassaemia. Such need calls for introduction of a blood reservation concept called blood banks where the collected bloods are stored until when needed. The first blood bank was established at the Cook County Hospital in United State of America in 1937 (Kim, 2002). Ever since then there have been series of such services in various part of the world.

Blood banking is a cache or bank of blood or blood components, gathered as a result of blood donation, stored and preserved for later use in blood transfusions (Kim, 2002; Khan & Quresh, 2009). Most hospital blood banks need to carry out series of pre-use testing on the collected sample to be sure that the blood is free of causing any harm when used. In addition to this, the blood type of patients also needs to be determined for compatibility sake for a blood transfusion. This is

either carried out by the collecting agency or a contracted laboratory. It is possible in some situations that the patient is unable to get the required amount of blood at the right time due to lack of interrelationship in form of a networked database among the blood banks which leads to the lack of knowledge of updated record of all blood donors.

This study tries to develop online blood banking, which will link all private banks of hospitals within one city with clear access to blood samples in the real time and right place and in turn solve non-availability of blood resulting from lack of information. Figure 1 below shows a typical blood bank. The use of blood banking is very important in satisfying the customers since it aids efficiency.

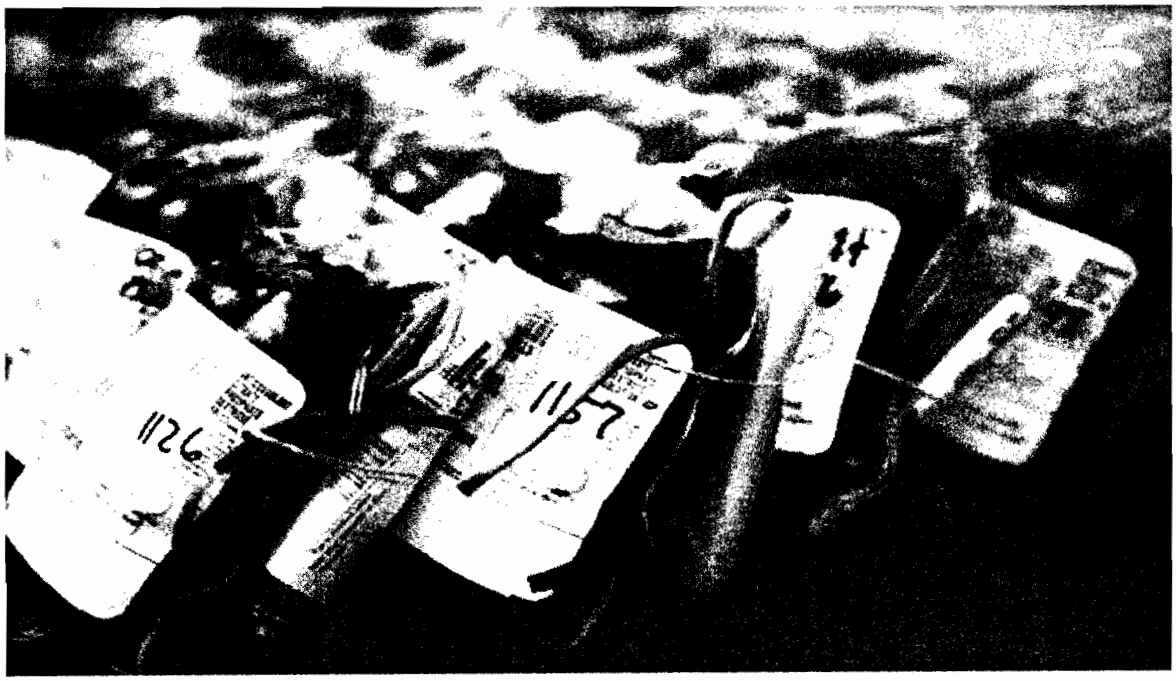


Figure 1.1 example of blood bank (Oliveri, 2008)

1.2 Problem Statement

The impact of blood banking has been stressed by a number of researchers in leading to the efficiency in the process of blood donation and transfusion (Kim, 2002; Oliveri, 2008). The banks have branches across different geographical locations where the donors donate their blood at all time. The issue is the problem of not having access to the blood banking information by other branches since the branches are not internetworked together. The quantities of blood in the branches of the blood bank is not always available and they do not know if the one of the branches of the blood bank has a shortage of blood or its components, while one of the branches has an excess of blood amount (Khan & Qureshi, 2009). According to Disaster Operations Handbook (2003), lack of proper inventory management has been the major cause of the problems in the blood banking since this lead to lack of adequate information about the availability of the blood and other associated information that can be helpful in either the donation or transfusion process. This is to be adequately handled in the study online blood banking system.

In some cases the patient cannot get the amount of blood at the right time due to the fact that the banks are not internetworked. The interest of the researcher in this regard is to present a way of solving this problem by developing an online blood banking system that can guarantee easy access of the blood donation information in all the branches involved.

1.3 Research Questions

The questions to be answered by this research are:

- In what ways can overall inventory management in blood banking be guaranteed?
- How can we develop an online blood banking system capable of handling excessive blood collection and inventory management?
- What is the usability of the developed prototype?

1.4 Objectives of the Study

In achieving the main objective of this study which is to develop online blood banking the following specific objectives are then constructed:

- To identify ways by which excess collection of blood can be controlled and overall inventory, management can be guaranteed.
- To develop an online internetworked blood banking capable of handling inventory management.
- To determine the usability of the developed prototype.

1.5 Significance of the Study

The benefit of developing the online blood banking is to link all blood banks within a wide geographical location together to enable the user to share information in a more effective manner. The system will automatically update the blood stored, and this research serves humanity by saving a lot of associated disasters associated with non-availability of blood when needed.

Blood banking done manually is ineffective because it is difficult to access current information. Moreover it is uneconomical and troublesome. Fortunately, the use of web based computer technology could enhance the effectiveness of IT management. The significance of the project are:

- Reduce paperwork which was previously handled in a traditional way.
- Delivering and retrieving information are much easier, faster, relevant and more efficient compared to manual filing system.
- Allow accessibility to the system and able to retrieve the most current information at anytime and anywhere using intranet or via internet.
- Allow user to easily up - get data via online and the center could manage the database easily.

1.6 Scope of The Study

This study will be carried out in blood bank which stores blood or blood components for later use in blood transfusions. A connection is to be made between all the blood banks to allow interconnectivity.

1.7 Organization Of The Report

This study is presented in five chapters. An overview of the content of the following chapters is as follows:

Chapter Two reviews the literature related to the blood banking, and Web applications.

Chapter Three describes the research methodology used in this study.

Chapter Four discusses the finding of this study based on the result of designing the system and implementing the prototype using the methodology suggested for this study.

Chapter Five will elaborate the result of this study.

Chapter Six concludes the study with conclusion, recommendations and directions for future work.

1.8 Summary

This chapter introduced the background of the study and the research problem that needs to be solved which gave direction and motivation for this study. The aim of this study has been identified as developing a web online internetworked blood banking site that is expected to help blood banking. In the next chapter, the related literature reviews are discussed.

Chapter Two

Literature Review

2.1 Introduction

This chapter is primarily to discuss the reviewed literature so as to establish an effective and efficient justification for the study. A background and a brief description of the study were introduced in the previous chapter. This chapter will shed more light concerning the ideas of the previous work related to designing online blood banking system.

2.2 Definition of Blood Banking

Blood banking according to the medical dictionary is defined as a place where human blood or any kind of blood plasma can be stored for later usage during transfusion. It is also defined as a place where the supplies of blood or plasma for transfusion are stored (Farlex, 2010). Blood banking is synonymous to blood donation, and blood donation is the process of collecting, testing, preparing and storing blood for future need. From the definition, what is central is the storage of blood for future transfusion and the blood or plasma are stored according to their types. This leads to the operational definition of a blood banking system as an automated way of storing blood or plasma according to their types in a central database system that will allow easy access to necessary information about the availability. Blood banking is very important in terms of its significant economies in the cost of blood bank operation and better utilization of available funds (Farlex, 2010).

2.2.1 Types of Blood

There is a need to discuss the typical types of blood since the storage is done based on the types of blood, and every human being is known for a particular blood type. Any blood banking system requires a knowledge based on all possible types of blood (Khan & Qureshi, 2009). The authors identified eight different types of blood in four ABO groups which might fall in to two main categories of Rh positive and Rh negative. The various types are O+, O-, A+, A-, B+, B-, AB+, AB -. Every human being is said to have each of the identified blood type, the blood or plasma stored in the blood banks are labeled according to their type and such enables the hospital to have a knowledge of the availability of the particular type of blood whenever such need is necessary. Consequently, it is highly risky to give a wrong blood to a patient. Therefore, adequate care needs to be taken while storing the blood and the best approach to do this is to store the blood type along with the blood itself.

2.2.2 The Process of Blood Donation

The average time of donating blood is about 20 minutes (Li, Chao & Dong, 2008). It involves inserting a sterile needle into a vein of the donor's arm. The blood then passes through a tube into the blood bag. Prior to the collection of blood, a specimen is first screened to ensure that the blood is free from any infections. The collected blood is then tagged with its type and then stored physically with the bag identity. The physically stored bags of blood can now be stored electronically for easy access and processing.

According to Boujtita (2008), the most important factor to be considered in blood banking is the time efficiency. It is believed that an efficient blood banking system is the one that is able to achieve the blood banking objective within the shortest possible time. The blood products are frequently desired and the extent at which the processing time can be reduced in blood banking is used as a competitive advantage over their competitors in the business. Thus, developing an online blood banking system will go a long way in reducing the time taken by avoiding the time wastage as a result of location barrier since information is available anywhere as long as there is an internet connection.

The growth in medical organizations has made the information processing in these organizations a bit challenging considering large size and business requirements (Kamran, Mohammad & Douglas, 2007). Therefore, managing the records of blood banking in such a growing organization requires a sophisticated technological approach similar to the proposed online blood banking that can guarantee ubiquitous blood banking services. Information and computer technology makes blood banking to be more popular due to its associated efficiency and service quality compared to the traditional blood banking system (Oba, Otani, Yasuda & Terada, 2001).

American software program called Appropriate Inventory Management (AIM) has been of immense benefits for member hospitals and it is believed to create a strong interrelationship between the hospitals and their member suppliers. AIM is a centrally hosted Web-based software system that helps hospitals determine optimal blood inventory levels to reduce blood product outdates and evaluate

blood usage and wastage by hospitals. It enables users to achieve peak blood management efficiencies by issuing system reports with performance benchmarking that allow comparisons of results with those of similar institutions (Li, Dong & Chao, 2008). The proposed online blood banking system will be discussed in detail in the later part of the study, and will focus mostly on how blood is being demanded from various branches. Figure 2.1 below describes a typical blood donation process at a blood donation centre adopted from Li and Dong (2006).

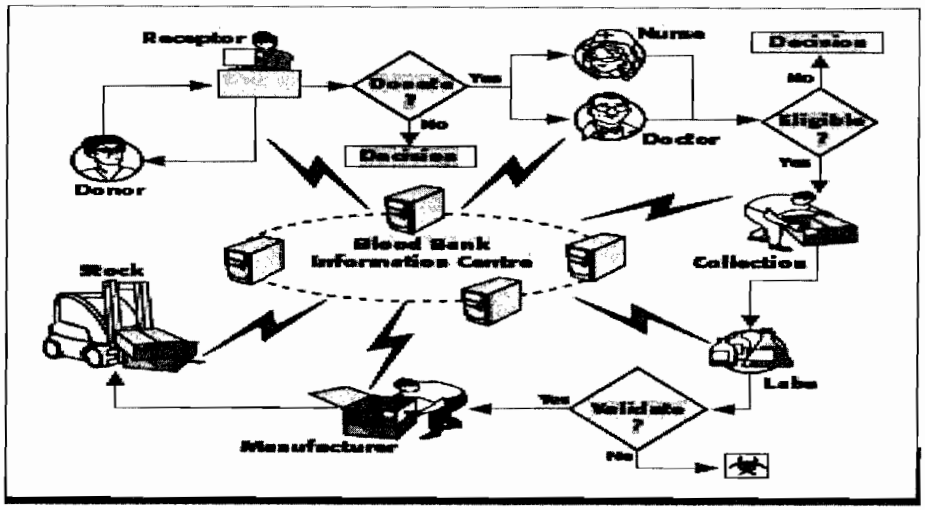


Figure 2.1: Blood donation at a blood centre (Source: Oba eta al., 2001)

2.2.3 Online Blood Banking System: Issues and Challenges

There have been series of blood control systems, and the first blood inventory system was designed and implemented in the United States in 1964 to respond to the need of the medium sized blood bank (Peterson, 1969). Thus, the new thing in this study is how to make such system an online system, by developing a web-based blood banking system. According to the author, system development for taking inventory of blood donated requires data collection, conversion, transmission, and computer data processing.

Previous researchers have revealed that one of the major problems associated with blood banking is having a kind of satisfactory control of the whole stocks of bloods at various hospitals that operate the blood bank (Peterson, 1969; Li & Dong, 2006). The authors stressed further that the 21days limitation on the usability of the entire blood calls for booking in advance for the quantities and types of blood that is going to be needed by the hospitals. All these pose a serious problem to the member hospitals. Therefore, there is need for an online blood banking system that can give up to date record of blood availability without any processing time required.

Kim, Yoo, Kim, Chang, Bae & Kim (2007) proposed ubiquitous blood bag management solution for preventing serious risk to patient's life as a result of using wrongly typed blood by tracking the location of a blood bag and ensure that the assigned blood is transported to the intended patient. In their study, this is achieved with the use of tag reader operation software. This is part of the gap that the proposed online blood banking is trying to fill. Integrating an online blood banking system into the hospital central information management system is expected to solve this kind of problem.

Li, Dong & Mang (2005) proposed the use of barcode technology which comprises of the machine-readable symbols used to encode information in order to automate a business process. Barcode also enables the machine to acquire data automatically via scanning, which can not only improve working efficiency but also avoid errors due to manual entries, as these calls for effective and efficient

automation of blood banking information management. In study, a machine readable symbol is used to encode blood banking information which provides unique identification of the blood bag and avoids the problem of wrong selection of blood bag. Similar approach is employed in the proposed online blood banking to ensure uniqueness of individual blood bag.

According to Khan & Quresh (2009), an automated blood donation system is considered useful to patients, doctors and researchers. It then means that researches on this area will have significant impact on the health sector irrespective of the society. This justifies the need for this study since the system will save the medical practitioners the stress of locating the required blood manually for transfusion which might result in delay.

Blood donation services is associated with a set of interdependent operations including donor registration, donation evaluation, blood collection, blood screening, component production, inventory management and blood dissemination (Li & Dong, 2006). The success of all these operations depends on how effective the inventory management is operating. This shows the need for an effective blood banking system. This is supported by the quotation of Li and Dong (2006) as follow: "All data should be an integral part of blood bank information system for centralized management"

Blood donation being a life-saving activity should be taken seriously in the academic environment and such activity is expected to be included in the curriculum at all levels of education to educate the students about the significance of donating blood (Lipscomb & Rosenstock, 1997).

This shows how blood banking is important in human life. Furthermore, training and awareness as regard to facilities are also included in the proposed online blood banking system prototype.

It is revealed that information and communication technology is associated with the recorded popularity in blood banking for efficiency and service quality (Li, Dong & Chao, 2008). This means that the traditional blood banking has been lacking in this regard. The proposed online blood banking system is going to be an added advantage in this regard. The authors also stress that mechanisms of computerized decision making have been explored to support blood bank information systems. The decision support system is implemented based on hybrid approach of knowledge-based expert system and data-driven statistical analysis. The system has its main application on services related to blood donation and transfusion. These operations are determined by blood bank professionals.

In developing blood bank information system, there are number of things that must be considered. The first thing to be considered is that the development should follow various technical specifications and industrial consensus. Secondly, the blood bank staff should specify various operational rules for donor screening, donation evaluation, sample testing, blood processing, and product dissemination. Finally, all statistical reports merely provide the basic analytical results to support decision making, whereas the blood bank staff are in the best position to make the final decision to improve efficiency (Li, Dong & Chao, 2008).

According to Guangpeng, Zhongwen, Song & Wenh (2009), a web-based real-time monitoring system is introduced on cold chain of blood to develop a system that can automatically inform staff when exception occurs. The authors proposed three different tasks which include wireless sensors that sense and send data to database server. Second, sensing data are stored into a database. The third is monitoring system which is an alarm mechanism that gives the alarm information to staff when the temperature or the relative humidity exceeds an acceptable limit. These types of systems are used to support unlimited access to information. There are many blood banks worldwide; they still operate locally using some forms of laboratory application software. The authors stressed that the manual documentation has led to a number of disastrous situations which calls for the implementation of an online banking system.

Khan & Qureshi (2009) proposed website system that enables users to search, collect and donate blood to the patients who are waiting blood and are almost in the point of death. Very few online systems exists that could assist humanity on time and save precious lives. Hence, online systems appear to have become most suitable for health care and life saving processes. The system is able to manipulate these real facts. The analyses reports showed that most of the people are unaware of the utility of such activities. In this context seminars and wide publicity are required for both male and female. But the system is not extended to interconnect all the blood donors' societies in the country through using LAN technology.

It is revealed that to curb the disasters that might result from lack of information on the availability and quantity of blood in the data bank, the American Association of Blood Banks (AABB) has defined the following Quality System Essentials (QSEs) parameters to be considered in the AABB 21st edition standards of blood banks and transfusion services (American Blood Centers, 2008).

Organization, resources, equipment, supplier and customer issues, process control, documents and records, deviation/non-conformances and complications, assessment: internal and external, process improvement through creativity and thus, prevention, facilities and safety. All these are equally important both in the inventory management and the blood banking itself.

Donation of blood online thus requires a number of steps as suggested by American Association of Blood Banks (AABB) and are stated below:

- Updating the personal details of the donors
- Booking an appointment for the blood donation with the centre
- View or change the appointments as may deem necessary
- View the recent donation history
- Check for the next donation time recommended

The implementation of the previous blood banking is server-based where the list of blood donors is hosted by the server computers in the forms of free service .The essence of such a programme is to ensure accurate and up-to-date information about the donors by regular update of donor's contact. This

information is not detailed enough since it fails to disclose any information about the availability of the required blood. The proposed online blood banking system in this study is expected to provide both information about the donors and the blood stocks (Bank, 2002).

Discussion

It should be noted that donating blood to patients is very important and requires certain processes which must be considered. Blood banking requires an effective barcode technology that can serve as a basis of blood banking information management that enables machine to acquire data automatically used for reducing errors and improving operational efficiencies. The American Association of Blood Banks (AABB) have recommended that Quality System Essentials (QSEs) must be put into consideration when it comes to donating blood to patients in order to avoid any kind of errors on the part of those in charge when it comes to blood donation.

All the above methodologies such as the barcode technology and the AABB of blood donation may seem to be very expensive and might not be affordable to all patients who are in need of blood which invariably might lead to loss of lives.

With all the clearly seen problems and importance of consistent need of blood to humanity, the researchers suggests that it will be better to develop an online internetworked system that will be able to instantly connect any branch of the blood bank requesting for blood and getting a feedback response on the status of blood in the branch by connecting the blood banking hub and center through the online internetworked system. This online blood banking system is a system that is user friendly, in as much as it is easy to use when it comes to accessing and

requesting for blood by patients, most especially for poor countries whose patients are not aware of the existence of less expensive applications such as the online blood banking system, and might not be able to afford expensive and non user friendly applications or systems, such as the barcode technology and AABB.

2.3 Web Applications Enabling Technologies

Web application is that kind of software application which can be can executed correctly only on the Web. Clearly, it is a software specifically designed for Web delivery, for example the Web-based journals (Gellersen et al., 1999). Usually, it consists of static resource files (e.g. Images), libraries, web components, and helper classes. A web browser is commonly used as a slim client, therefore, all the processes are executed on the server. Web applications are typically organized in three-level architecture and they are: user interface level, functional process logic level, and data storage level. The user-interface level represented by web browser, and the functional level represented by the dynamic web content technology such as CGI, ASP or Java. Data Storage is handled by a database.

Web applications are extension of a web server (Armstrong et al, 2004). Web applications can either be service oriented or presentation oriented. A presentation oriented web application produces interactive web pages containing mark up languages like (XML and HTML) and dynamic content in response to requests. Many of these open sources LAMP (Linux, Apache, MySQL and PHP). A service oriented web application then implements the endpoint of the web service.

2.3.1 Linux, Apache, MySQL and PHP (LAMP)

Linux, Apache, MySQL, and PHP/Perl/Python (LAMP) are a group of software more and more being used to run dynamic web sites. They are basically free as such and they are very popular. Any user can download such open source software easily from the Internet, or they can appear as a bundled with Linux distributions (Dougherty, 2001).

- **Apache:** A very famous open source HTTP Web Server developed by the Apache Software Foundation. Apache is characterized by its highly configurable error messages, DBMS-based authentication databases and content negotiation and support for various GUI's. Apache is also distributed in other proprietary packages like the Oracle Database and the IBM Web sphere application server. It is very useful, and as such Apache logs can be analyzed using a web browser and some freely available scripts (Webservice20, 2004).

- **MySQL**: MySQL is a multi-user, multithreaded SQL relational database server. Programming languages that can access a MySQL database include C, C++, Java, PHP, and Perl. The MyODBC interface allows other programming languages which support the ODBC interface to communicate with MySQL. MySQL runs on many different operating systems including Linux and Windows. MySQL 5.1. Offers a lot of improvement over previous versions including transactions, SSL support, nested SELECTS ACID compliance and Query Caching. It is very important to note that it support Triggers or Cursors. It supports Stored Procedures and Views (Thefreelibrary, 2005).

- **Java/J2EE**: The Java 2 Platform Enterprise Edition (J2EE) gives the tools and Application Programming Interfaces (API's) that developers need to build and deploy concerning web services and clients. According to Sun, "The J2EE platform simplifies enterprise applications by basing them on standardized, modular components, by providing a complete set of services to those components, and by handling many details of application behavior automatically, without complex programming." The Java 2 Platform, Enterprise Edition has complete support for Enterprise JavaBeans components, Java Servlets API and JavaServer Pages and XML Technology (Nwaiwu, 2005).

  Web components like JavaServer Pages (JSP) and Java Servlets provide dynamic extension capabilities for web servers. A client sends a HTTP request to a web server which implements the Java Servlet and JavaServer Pages technology. The web server converts the request into an HTTP ServeletRequest object which is delivered to a web component. The web components interact with JavaBeans or a database to generate dynamic content. A particular web component produces a HTTP ServleResponse object which is converted by the web server into a HTTP response that is sent to the client. (Armstrong et al, 2004).

  In addition, these web components can run on the Tomcat Web container supplied in the Java Web Services Development Pack (JWSDP). Tomcat provides services such as life cycle management, concurrency, security and requests as well as providing accesses for components to API's for transactions, email etc (Bodoff et al., 2002) .

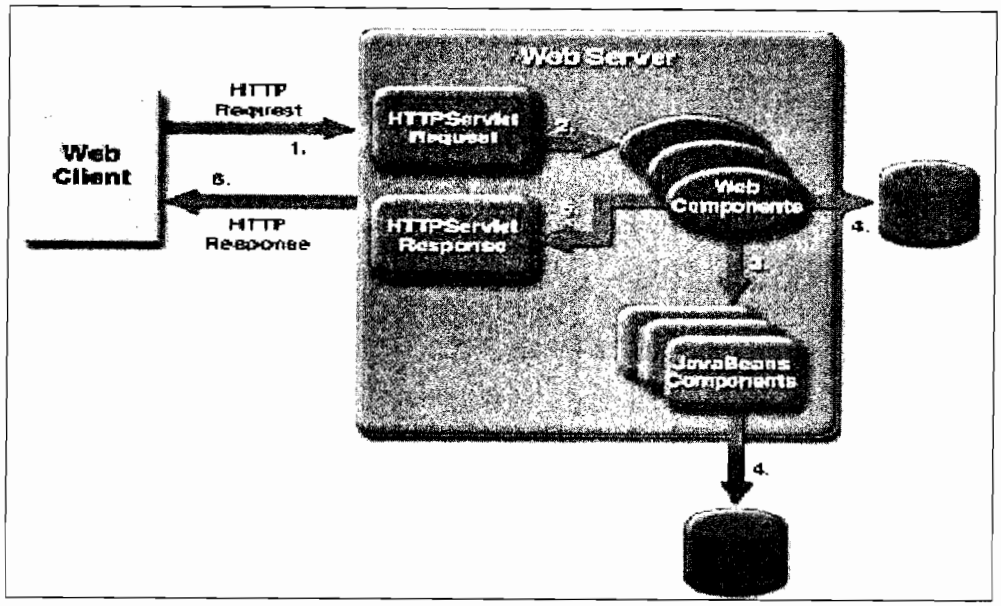


Figure 2.2: Java Web Application Request Handling (Source: Bodoff, et al 2002)

Advantage java application:

- It supports the development by a team which has variation in terms of application development, skill and experience. The web designers and developers roles can be clearly separated.
- The facilities provided by the repository (application server) can be leveraged for fast development and deployment (Sun, 2010).
- Standards based application server ensures interpretability and seller neutrality.
- Similarly, availability of open source application servers like JBoss along with database server like MySql, allows both development and deployment to be extremely cost effective as compared to other proprietary application development platforms (Sun, 2010).

- Coding convenience JSP syntax allows you a shortcut for coding dynamic Web pages, typically requiring much less code than equivalent servlet code. The JSP translator also automatically handles some servlet coding overhead for you, such as implementing standard JSP/servlet interfaces and creating HTTP sessions (Oracle, 2010).

- Separation of static content and dynamic content JSP technology allows separating the development efforts between the HTML code that determines static page presentation, and the Java code that processes business logic and presents dynamic content. It therefore becomes much easier to split maintenance responsibilities between presentation and layout specialists who may be proficient in HTML but not Java, and code specialists who may be proficient in Java but not HTML. In a typical JSP page, most Java code and business logic will not be within snippets embedded in the JSP page instead, it will be in JavaBeans or Enterprise JavaBeans that are invoked from the JSP page (Oracle, 2010).

2.4 Summary

This chapter discussed all the necessary literatures to ground the need for this study and also to identify the important components of the proposed online blood banking system. The discussion in this chapter included the introduction, concepts definition, blood donation processes and issues related to blood banking automation.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology is more than just a collection of methods to perform a research; it is a systematic way to solve the research problem (Kothari, 1985). The research methods refer to the methods and techniques used by the researcher in performing the research, for example data collection technique, data processing techniques and instruments.

3.2 Research Methodology

In achieving the set objectives in this study, a detailed review will be carried out in determining the requirements of the developing online blood banking system as revealed by authors in this field of research. The first stage involves gathering the system requirements and the prototype as designed using the general software designing methodology with specific emphasis on the Rational Unified Process (RUP). Finally, General Research Design Methodology will be used in this study, and this Methodology as proposed by (Vaishnavi & Kuechler, 2004). This methodology contains five major phases as shown in the figure 3.1 below:

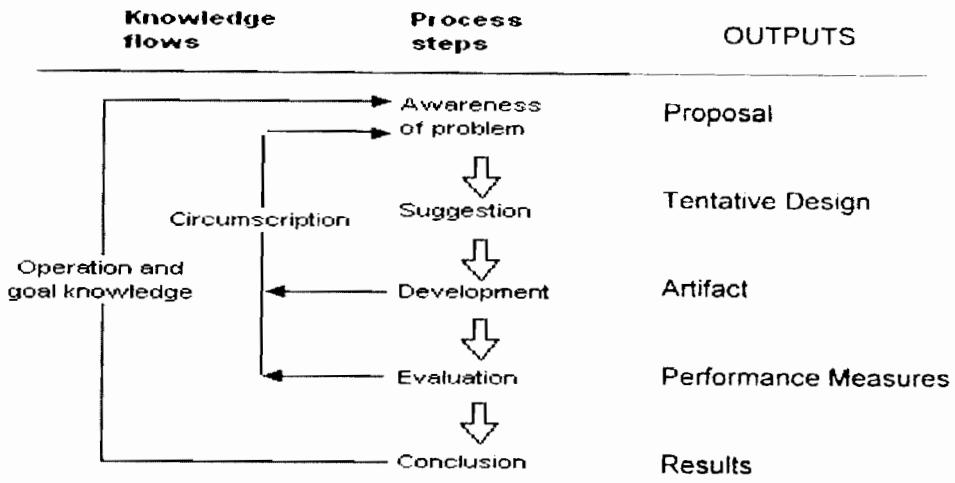


Figure 3.1: Research Design Methodology (Vaishnavi & Kuechler, 2004)

3.2.1Awareness of Problem

Generally, understanding a problem means getting closer to the solution, the first fundamental step in this study is to clearly define the problem by specifying the requirements in an understandable way. Requirement identification is the major step in the prototype development. Also, understanding the objectives and the scope of the study are equally important information that has to do with clarifying the problems in this study mainly from previous related literatures.

3.2.2 Suggestion

The study is aimed at recommending the use of online blood banking system that will be capable of connecting all branches of blood banks together. In doing this, a prototype will be developed to explain the feasibility study of such application in real life situation. The output of this phase is the Tentative Design which has

to do with discovering those unsure or uncertain circumstances. The design of the system includes WAE for UML diagrams. The UML diagrams capture the fundamental system requirements.

3.2.3 Development

After designing the initial prototype, the prototyping process contains three main steps which were adapted from (Laudon & Laudon, 2000), as shown in Figure 3.2 below. By interacting with the prototype, users can get a better idea of their information requirements. The application approved by the users can be used as a template to create the final system. The users are those who are involved in the process of blood banking, and for this study, the staff of blood banking unit of hospital Jitra are involved.

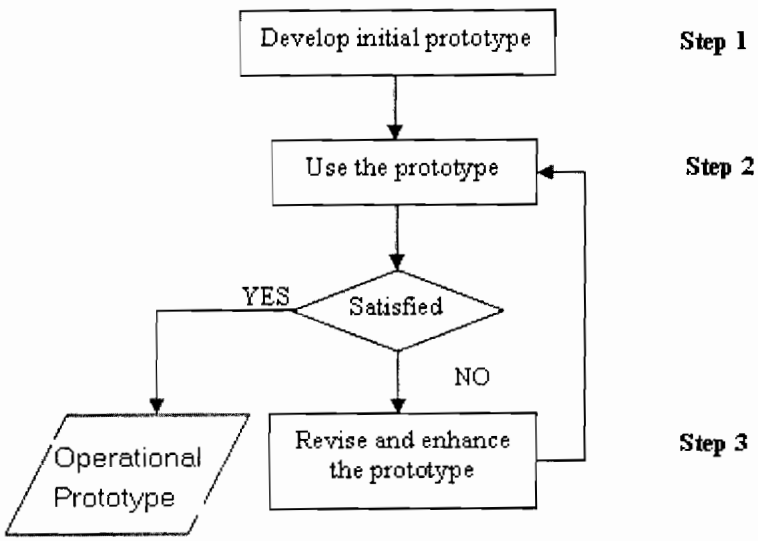


Figure3.2: The Prototyping Processes (Laudon & Laudon, 2000).

Step 1: **Develop Initial Prototype**: The first step in the implementation of this project involves the development of the online blood banking prototype based on

the initial requirements gathered. It is expected that the requirements will be reviewed after the prototype is tested by the intended users. The prototype development process is discussed separately later in this chapter.

Step 2: **Use the Prototype:** This step entails executing the developed prototype to ascertain that all the requirements are adequately captured. Any forms of disparity discovered are accommodated by moderating the requirements.

Step 3: **Revise and Enhance the Prototype:** After putting the prototype into use it will be evaluated to examine both the functional and non-functional requirements in the system. The result of the evaluation will determine whether the project should be continued or not. Additionally, the proposed system prototype is evaluated by examining the usability, with the use of questionnaires for system usability evaluation. Usability evaluation is known to combine both subjective and objective quantitative data in the context of realistic scenarios- of-use, and explaining the problems by responding to participant who wants to complete the scenarios which will be discussed later (Lewis, 1995).

3.2.4 Evaluation

Evaluation will be conducted to determine the user's perception on the usability aspect of the prototype. The results of the usability test are explained in detail in chapter 5 in the system evaluation section. The test made use of the IBM's Computer System Usability Questionnaire (CSUQ) and the questionnaire questions were prepared and adopted (Lewis, 1995). All questions in the Questionnaire will be measured using the Likert Scale format ranging from 1 to 5 as in Table 3.1 (Best & Kahn, 2003).

Table 3.1: Likert Scale Classification

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Score	1	2	3	4	5
Category	Disagree		Neutral	Agree	

3.2.5 Conclusion:

The conclusion of this research work will emphasize on aspects related to the usefulness and functions of what the system will do, and basically what the system is all about. Furthermore, it will also emphasize on the problems and limitations that were encountered during the development of the project, as well as the future development that is considered to be very vital and important with regards to the project.

3.3 Cycle of RUP

RUP offers a restricted well formed way to assigning responsibilities and tasks inside a development organization. Its target is to ensure high quality software that meets the requirements of end-users, within schedule and budget (Rational Software, 1998).

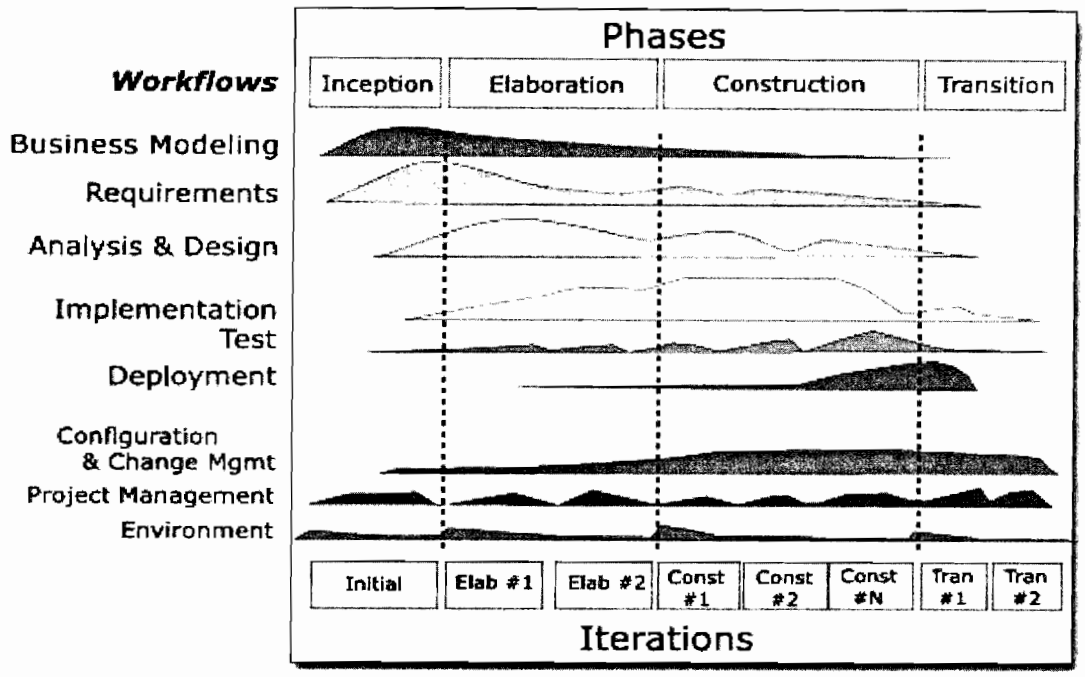


Figure 3.3: Rational Unified Process (RUP) (Kruchten, 2001).

3.3.1 Business Modeling

One of the main troubles with the majority of business engineering efforts is that the software engineering and the business engineering community do not communicate suitably with each other. This results in the output from business engineering is not used appropriately as input in the software development effort, and vice versa.

The Rational Unified Process deals with this by providing a common language and process for both communities, as well as showing how to build and sustain direct traceability between business and software models.

The major goal of this study relates to the researcher understanding, of study of online blood banking system. During the review of the literature, ideas, information, questions and problems relating to this area will be collected.

For example, it is used to answer the questions of what requirements are needed to build the online blood banking system or what is the best way that can be applied to help blood bank manage its blood demand?

3.3.2 Requirements

The aim of the Requirements workflow is to portray what the system has to do and permit the customer and the developer to agree on that sketch. To carry out this, researcher draws out, categorizes, and documents the required functionality.

For this study, system requirements need to be defined clearly and requirements need to be gathered efficiently in order to build an effective online blood banking system. Consequently, the advantage is to investigate the current practices of managing blood demand in blood bank center, and to propose and develop an online blood banking system for blood bank.

The researcher used interview as a means of collecting information, as well as the data needed for the project work for observing the current system. The researcher interviewed an officer in charge of the bio chemist department of the pathology unit from Jitra Hospital. The researcher asked him about the current system. How they contact the other branches if they wanted to request for blood. What kind of problems they normally encounter when they want to request the blood. The officer made the researcher understand that they demand blood manually through the use of telephone. The officer also explained further that using this kind of method is time consuming .Apart from all these, the officer made the researcher understand the fact that, by using manual system, it does not

allow the central blood bank to have access to detailed information about the amount of blood in their hospital.

As it was illustrated in appendix A, interview questions led to the discovery of the Functional Requirements by the researcher that served as basis for developing the online blood banking system, and the users of this system tend to be the staff of the central blood bank, and their staff in the other branches. The Functional Requirements include the following. View Bank Information, Blood Demand, Update bank information, Manage system, and View Report. The Functional Requirements will be explained in more detailed in chapter four.

Another kind of requirement is the Non Functional Requirement. According to (Glinz, 2007), the Non Functional Requirement is a System requirement that describes not only what the system will do, but how it will be done. Glinz said that the Non-Functional requirement should be put into consideration and should not be left untouched in as much as it is also an important function when it comes to identifying system requirement. Examples are: system performance requirements, system external interface requirements, design constraints, and system quality attributes. Non Functional Requirements can also be called the 'Ilities' because they are most simply expressed like these:

1- Reliability	2- Usability	3- Response Time
4- Security	5- Maintainability	6- Portability

3.3.3 Analysis and Design

The aim of the Analysis & Design workflow is to show how the system will be understood in the next phase. The planned system is to perform online application using Java Server Pages (JSP). The design that will be produced in this phase will describe the following features of the system:

Table 3.2 System Functions

function	Center	Branch
Login	✓	✓
View Information	✓	✓
Blood Demand		✓
Update Branch Information		✓
Manage System	✓	
View report	✓	✓

The functions will be specified by the use case, sequence and class diagrams. Object oriented systems analysis and design primarily employ use case diagrams, sequence diagrams, and class diagrams to describe the analysis model of a system (George et al, 2004). Important roles of these diagrams in SAD are also confirmed by a recent empirical study where they were found to be the three most commonly used UML diagrams in practice (Dobing & Parsons, 2006).

3.3.4 Implementation

After the Analysis and the design phase, the research process will be made use of in the development of the prototype system of online blood banking. The completed design will be translated into program code. In this phase, the researcher will use the object oriented programming to create all the components of blood bank system and codes of client and server components to access and retrieve data from databases.

For the server side, Windows 2003 will be used as a Web Application Server. Apache Tomcat Jakarta is already integrated in Windows 2003 Server to make it easy to share documents and information across the Internet.

3.3.5 Usability Testing

The goals of the testing workflow include:

- To validate that all functional requirements have been properly implemented.
- To validate the interaction between the objects.

After Programming is completed, the online blood banking system will be tested through the people who will use it, to know if the system matches the requirements of blood demand. Any problem encountered will be analyzed to fix the system to ensure it will provide correct services. These fixing steps include problem of software and hardware configuration. To test the system of online blood banking, the evaluation will be achieved using a questionnaire illustrated in the appendix B. Five (5) doctors in Jitra hospital are considered as the respondents since they are part of the current problem associated with the

demand of blood in blood bank. The results of the evaluation study are presented in chapter five. In this study the researcher was unable to ascertain the Non Functional Requirement because the system was tested locally by the researcher; invariably the Non Functional Requirements will be determined by the real users of the system who tend to be the staff of the blood bank after the implementation of the system.

3.3.6 Deployment

The scope of the deployment of the online blood banking system is yet to be covered for now, invariably it will be discussed in chapter six by the researcher.

3.4 Summary

This chapter gives the directions to be followed in order to achieve the study's objectives with more emphasis to the strategies used in designing the proposed online blood banking prototype. The discussion serves as a guide or a roadmap in carrying out the activities involved in this study.

CHAPTER 4

THE DESIGN OF ONLINE BLOOD BANKING SYSTEM

4.1 Introduction

This chapter deals with the design and implementation of the study. It therefore introduces the system requirements by using the Unified Modeling Language (UML), which is an open method that is used to specify, visualize, construct and document the artifacts of an object-oriented software-intensive system under this developmental stage.UML offers a standard way to write the system's blueprints, including the conceptual components (Glinz,2007). This chapter covers the design and implementation of the Online Blood Banking System. The functional requirements were gathered from the blood bank's staff that uses the system. The chapter touches on the system architecture followed by designing the graphical user interface (GUI) of the prototype system as well as the system database.

4.2 Result of Interview

This is based on what the researcher has discussed earlier on concerning the collection of information or data through the use of interview, by interviewing an officer in charge of the bio-chemist department of the pathology unit from Jitra Hospital. The interview questions were centered on the problems related to demand of blood. The researcher suggested developing an online blood banking system and the officer in charge of the bio-chemist department of the pathology unit supported

the idea. The researcher therefore suggests the use of online blood banking system as a means of conducting their operational activities basically, to tackle the existing problems they are passing through, and which invariably will enhance and improve their ways of seeking and as such managing blood through the use of the online blood banking system.

4.3List of Requirement

Requirement refers to the necessary actions to be carried out by the system which can be seen from two perspectives, that is from the business perspective and the user's perspective. The requirement has two types: the functional and non functional requirement.

A requirement is a term expressing in terms of what the system will do, or what characteristics it must contain. Requirements in the analysis parts are written from business perspective (business requirements/ user requirements) to the focus of the system (system requirements). Requirement has two types: Functional requirement and non- functional requirement

4.3.1 Functional Requirement

Functional requirement is the process which the system needs to perform. This means it is a basic requirement because it describes what the system will do. (As is shown in table 4.1).The functional requirements and non-functional requirement of the system are listed below. In the priority column, the following abbreviations are used:

- M – Mandatory requirements (something the system must do).
- D – Desirable requirements (something the system preferably should do).
- O – Optional requirements (something the system may do).

Table 4.1 Functional Requirements

No.	Requirement ID	Requirement Description	Priority
	OBBS_01	**Login**	
1.	OBBS _01_01	Center and Branch can key in the user name and password.	M
2.	OBBS _01_02	If user key in wrong user name or password the system will display error message and ask to re-enter the user name and the password again.	M
	OBBS -02	**View Information**	
3.	OBBS _02_01	The user (Branch) has the ability to view information about the blood banking and details amount of blood.	M
4.	**OBBS _02_02**	The Center has ability to view all details information about all users (Branch) amount blood.	M
	OBBS _03	**Blood Demand**	
5.	OBBS _03_01	Branch can select blood demand to manage blood demand.	M
6.	OBBS _03_02	Branch can select details information the request.	M
7.	OBBS _03_03	The system will display information about available amounts of blood.	M
8.	OBBS _03_04	Branch will choose suitable branch.	M
	OBBS _04	**Update Branch Information**	
9	OBBS _04_01	Branch can update the information (address – amount blood)	O
	OBBS _05	**Manage System**	
10.	OBBS _05_01	Center can add and delete Branches. The system will Update the data base after each operation done by the Center.	O

	OBBS _06	**View report**	
11.	OBBS _06_01	Center can view all the blood demands report from all Branches.	O
12.	OBBS _06_02	Branch can view report about demands	O

4.3.2 Non Functional Requirement

Non-functional requirement helps in the "most critical" requirement analysis. This is because it can be used to determine the best choice for developing system as shown in table 4.2.

Table 4.2 NON Functional Requirements

No.	Requirement ID	Requirement Description	Priority
	OBBS _08	**Reliability issues**	
15.	OBBS _08_01	The system should be capable of processing within a given time frame with no errors and the system should be available and operational all the time (real time)	M
	OBBS _09	**Usability issues**	
16.	OBBS _09_01	The system must be easy to use.	M
	OBBS _10	**Response Time / Speed**	
17.	OBBS _10_01	The system should be able to process any transaction at the highest speed and avoid unnecessary interaction.	M

	OBBS _11	**Security issues**	
18.	OBBS _11_01	The system should not compromise the user information at any time. The user information will never be sold to other parties and will be kept secure at all times. Users will be authenticated to ensure that no unauthorized users gain access to private information.	M
	OBBS _12	**Maintainability issues**	
19.	OBBS _12_01	The system source code will be kept well structure and documented so that it is easier to maintain and extend the system. All changes to the system must be documented.	M
	OBBS _13	**Portability issues**	
20.	OBBS _13_01	The OBBS must be supported by different type of hardware and system (for example; windows, Unix.., etc).	M

4.4 Use Case Diagram

The UML shows the diagram as behavioral which is defined by use- case analysis. It is purposely to present an overview of the system functionality in terms of the actors and other dependencies (Wikipedia, 2010). This system is all about online blood reservation in blood banks of various branches.

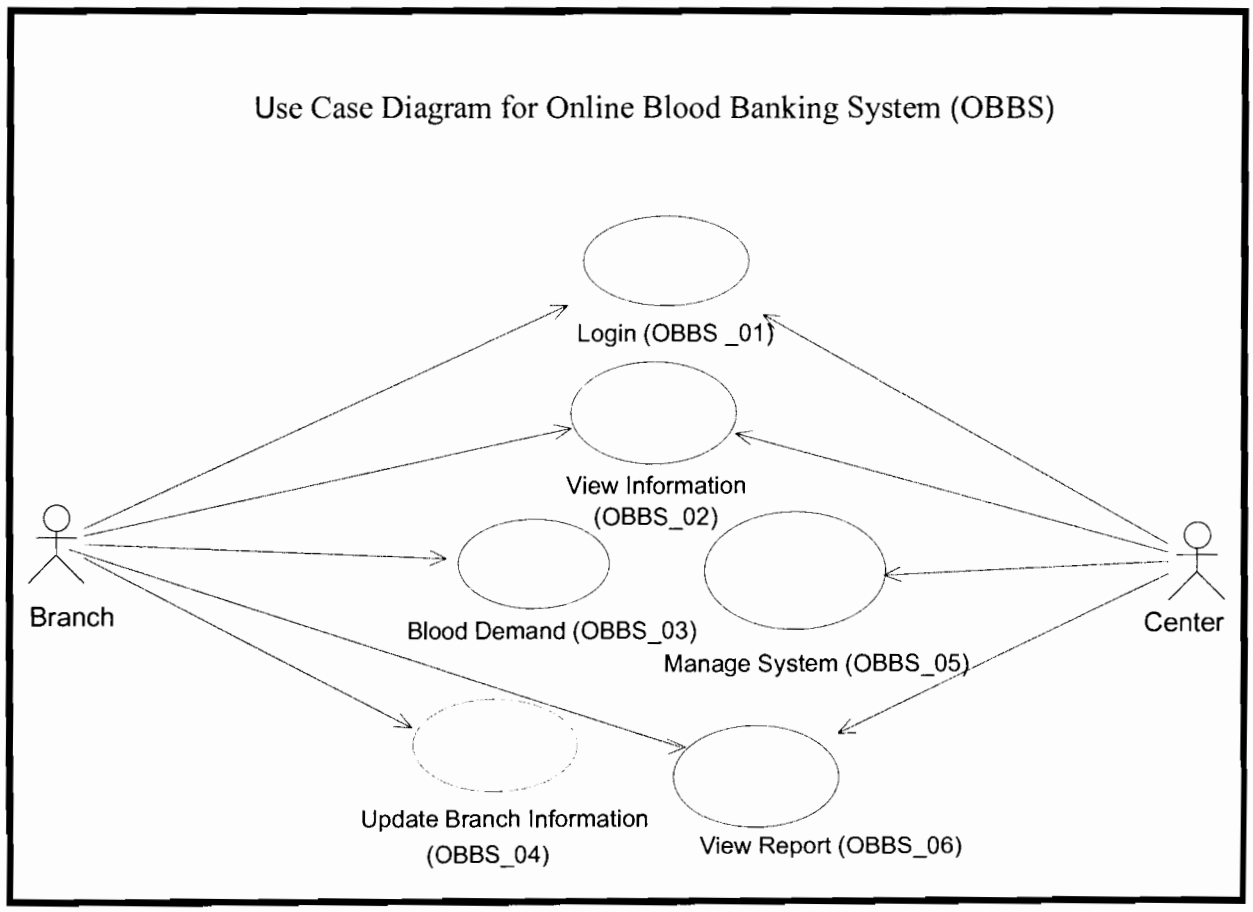


Figure 4.1: Use Case Diagram

4.5 Use Case Specification

The log in use case specification, View Information, Blood Demand, Update Branch Information, Manage System and View Report are shown in figures 4.2 to figures 4.7 respectively.

<table>
<tr><td colspan="2">Use Case Name: LOG IN</td><td>ID: OBBS _01</td><td>Importance Level: High</td></tr>
<tr><td colspan="4">Primary Actor: Branch /Center</td></tr>
<tr><td colspan="4"><u>Short Description</u>: This use case allows the Branch or Centre to access their account by typing the right user name and password.</td></tr>
<tr><td colspan="4">Type: <u>External</u> / Temporal</td></tr>
<tr><td colspan="2"><u>Basic Flow of Events</u>

Branch /Center

1. This use case begin when the user click on Branch or Center button.

3. The user should key in his user name and password then click on log in (E1: error message).</td><td colspan="2">

System

2. The system displays the log in page contains user name and password fields.

4. The system displays the page of the use.</td></tr>
<tr><td colspan="2"><u>Alternatives</u>

Not applicable.</td><td colspan="2"></td></tr>
<tr><td colspan="2"><u>Exceptions : E1</u></td><td colspan="2">1. The system will display error message key-in wrong password or user name.</td></tr>
<tr><td colspan="4"><u>Characteristic of Activation</u>

Press log in button.</td></tr>
<tr><td colspan="4"><u>Pre-conditions</u>

The user must be a member of Online Blood Banking System.</td></tr>
<tr><td colspan="4"><u>Post-conditions</u>

Access to user page.</td></tr>
</table>

Figure 4.2: Login Use Case Specification.

Use Case Name: **View Information**	ID: OBBS _02	Importance Level: **High**
Primary Actor: **Branch /Center**		
Short Description: The use case here allows the Centre and Branch to view information about the details amount of blood in the branches blood bank.		
Type: **External** / Temporal		

Basic Flow of Events	
Branch /center	**System**
1. This use case begins when the Center and Branch accesses the website by click on view button. **3.** The Branch can view information about the amount of the blood in the branch. **4.** The Centre can view all details amounts of blood available from all branches.	**2.** The system displays the information from the Branch. **5.** This use case end when the Center and Branch exit.
Alternatives Not applicable	
Exceptions : Not applicable	
Characteristic of Activation Press on button view.	
Pre-conditions The centre and Branch are Login to the system.	
Post-conditions Info page displayed	

Figure 4.3: View Information Use Case Specification.

Use Case Name: **Blood Demand**	ID: OBBS _03	Importance Level: **High**
Primary Actor: **Branch**		
Short Description: This function allows the Branch to determine those blood bank branches that are having enough blood from which they can demand blood from, and the kind of blood needed, and to have access to reservation of the amount of blood that are available.		
Type: **External** / Temporal		
Basic Flow of Events **Branch** 1. This use case begins when the Branch access to the home page and click on demand button. **3.** The Branch fill fields Name, Date, Blood Group, Amount Blood, address and click on Submit button. **5.** The Branch selects the suitable place and click on the button. **7.** The Branch can print the information demand report. .	 **System** **2.** The system displays demand page. **4.** The system display places (branches) that have the available amount of blood on new page. **6.** The system display successfully message and print button appear. **8.** This use case is end when the Branch finishes complete demand.	
Alternatives Not applicable		
Exceptions : Not applicable		
Characteristic of Activation Click on demand button.		
Pre-conditions The Branch should login the home page.		
Post-conditions Request done.		

Figure 4.4: Blood Demand Use Case Specification.

Use Case Name: **Update Branch Information**	ID: OBBS _04	Importance Level: **High**
Primary Actor: **Branch**		
Short Description: This use case initiate the Branch to updates its information.		
Type: **External** / Temporal		
Basic Flow of Events **Branch** **1.** This use case begins when the Branch access to the home and Click on button. **3.** The Branch can modify its information (address, amount blood, Blood Group) and press on save button.	**System** **2.** The system display information page. **4.** The system displays successfully message. **5.** This use case is end when the Branch completes the update.	
Alternatives Not applicable.		
Exceptions : Not applicable.		
Characteristic of Activation Click on Update button.		
Pre-conditions The Branch should login the home page.		
Post-conditions Information updated.		

Figure 4.5: Update Branch Information Use Case Specification.

Use Case Name: **Manage System**	ID: OBBS _05	Importance Level: **High**
Primary Actor: **Center**		
Short Description: This use case initiates the Center to add, update and delete Branch.		
Type: **External** / Temporal		
Basic Flow of Events **Center** **1.** This use case begins when the Center access to the home and Click on add or delete or update button. **2.** The Center can add, update, and delete Branch. **4.** This use case is accomplished when the Center finishes its entire operations.	**System** **3.** The system displays confirmation message.	
Alternatives Not applicable.		
Exceptions : Not applicable.		
Characteristic of Activation Click on add, update, and delete button.		
Pre-conditions The Center should login the center page.		
Post-conditions Data updated.		

Figure 4.6: Manage System Use Case Specification.

Use Case Name: **View Report**	ID: OBBS _06	Importance Level: **High**
Primary Actor: **Branch /center**		
Short Description: This use case is initiated by the Center and Branch to view the report.		
Type: **External** / Temporal		

Basic Flow of Events	
Branch /Center	**System**
1. This use case begins when the Center and Branch access the home and Click on Report button.	**2.** The system displays the report.
3. The Center views all detail of blood demands of all branches.	
4. The Branch can view the blood demands in every branch.	
Alternatives Not applicable.	
Exceptions : Not applicable.	

Characteristic of Activation
Click on Report button.
Pre-conditions
The Center and Branch should login the home page.
Post-conditions
Info page displayed.

Figure 4.7: View Report Use Case Specification.

4.6 Sequence Diagram

According to (Johan, 2004) the sequence diagram is a kind of Interaction diagram that is used to describe the object interaction. The sequence diagram shows the interactions among objects that participate in the use case and the message that passes between them over time for one use case.

4.6.1 Log-in

This diagram shows the sequence operations of log-in function. This operation is done in such a way that the centre and branch must enter a particular password and user name before they can access to the system. Then system must verify and validate it. If they key in the incorrect password or username, the system will display error message.

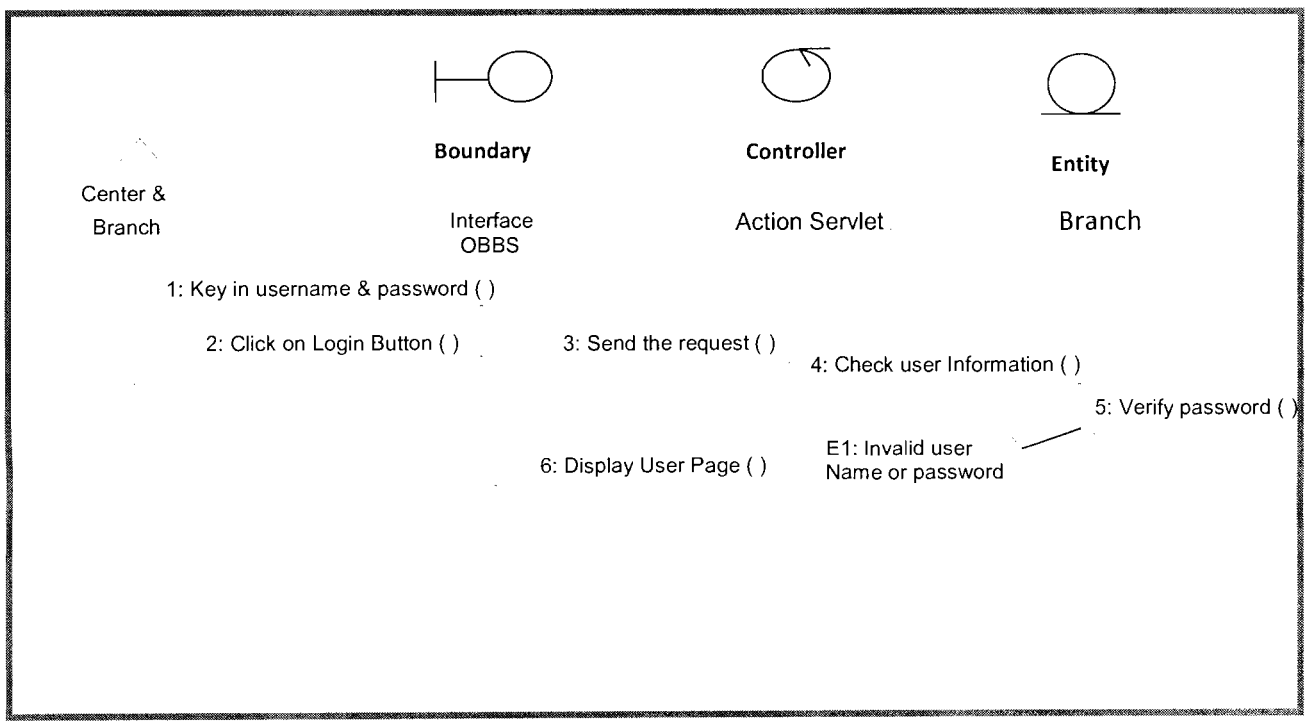


Figure 4.8: Sequence Diagram for Log-in

4.6.2 View Information

This diagram shows the sequence of view information sequence. It shows the way the user can see user's information by clicking on view button. Then the system will access the DB and read data then display the information page will be displayed .The branch can see all information of the branch, and the Centre can see all information of all branches.

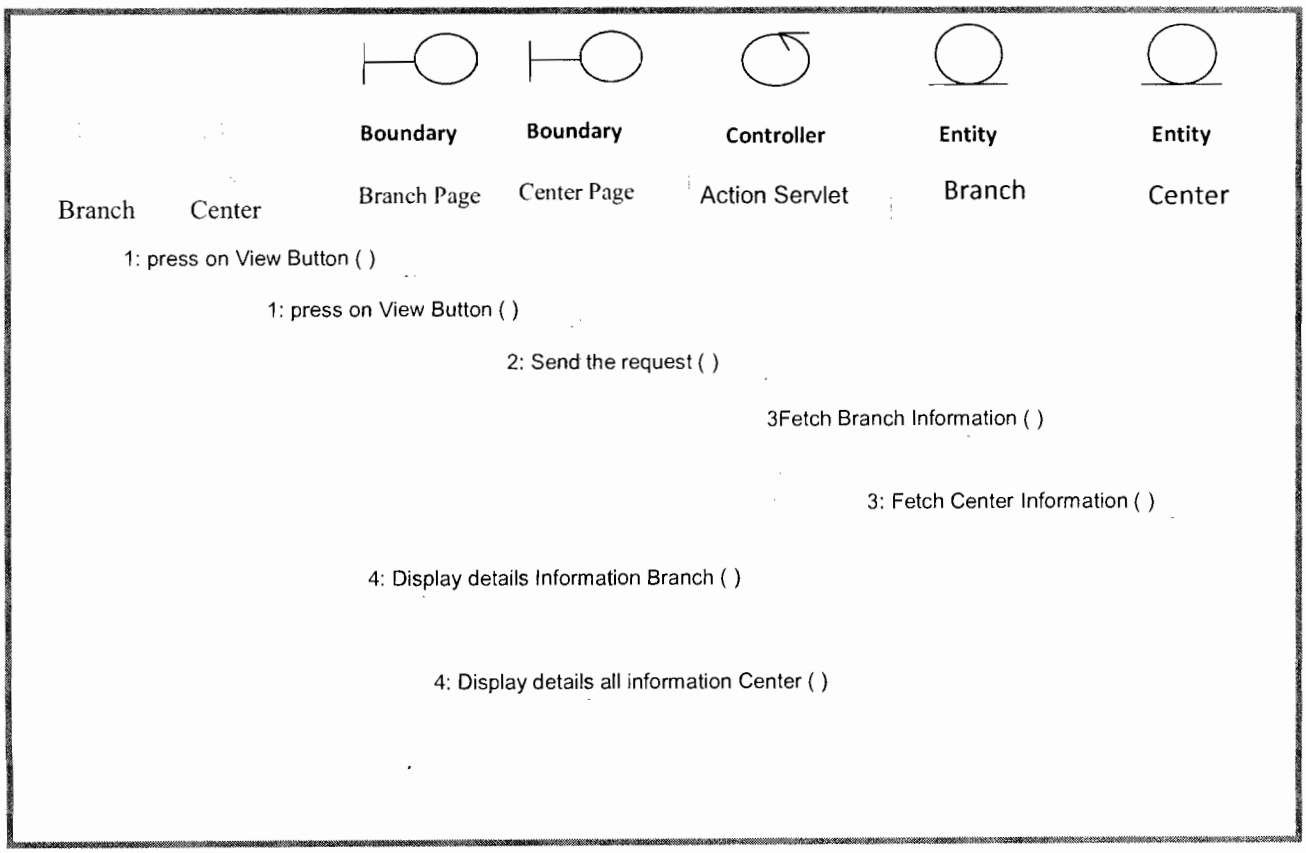


Figure 4.9: Sequence Diagram for View Information

4.6.3 Blood Demand

This diagram shows the sequence of Blood Demand. It shows how the Branch can request for a certain amount of blood by clicking on Demand button. This will fill information page and press continue button, the system will display branches that have the required amount blood. After that select the branch and then press submit button.

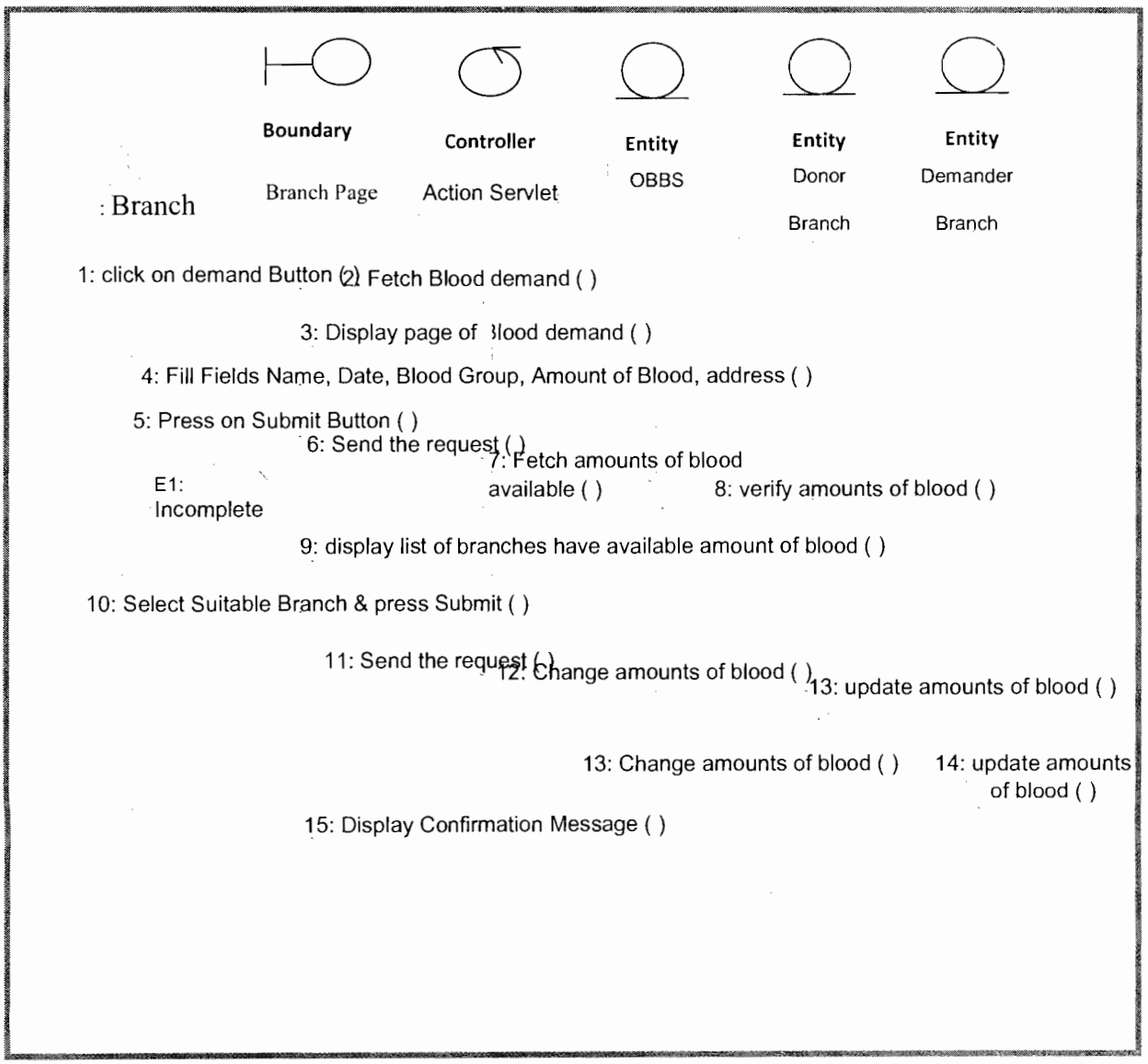


Figure 4.10: Sequence Diagram for Blood Demand

4.6.4 Update Branch Information

This sequence diagram shows how to update Branch information. After the Branch click on update button, then the system display the Branch information. The branch can modify information and then click on submit button to save the updates.

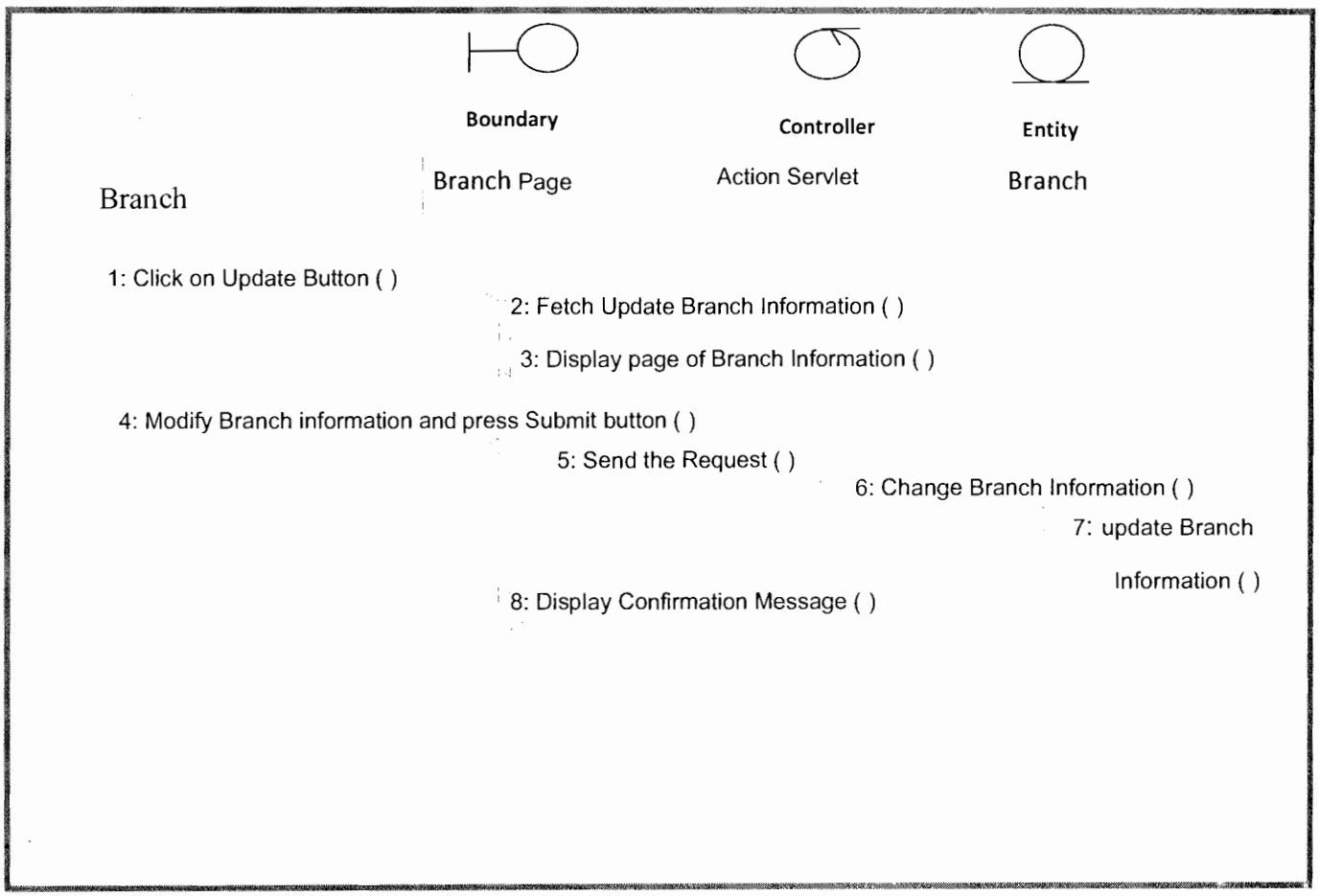


Figure 4.11: Sequence Diagram for Update Branch Information

4.6.5 Manage System

This diagram shows the sequence of the way the system is being managed. The centre Manager can add or delete branch.

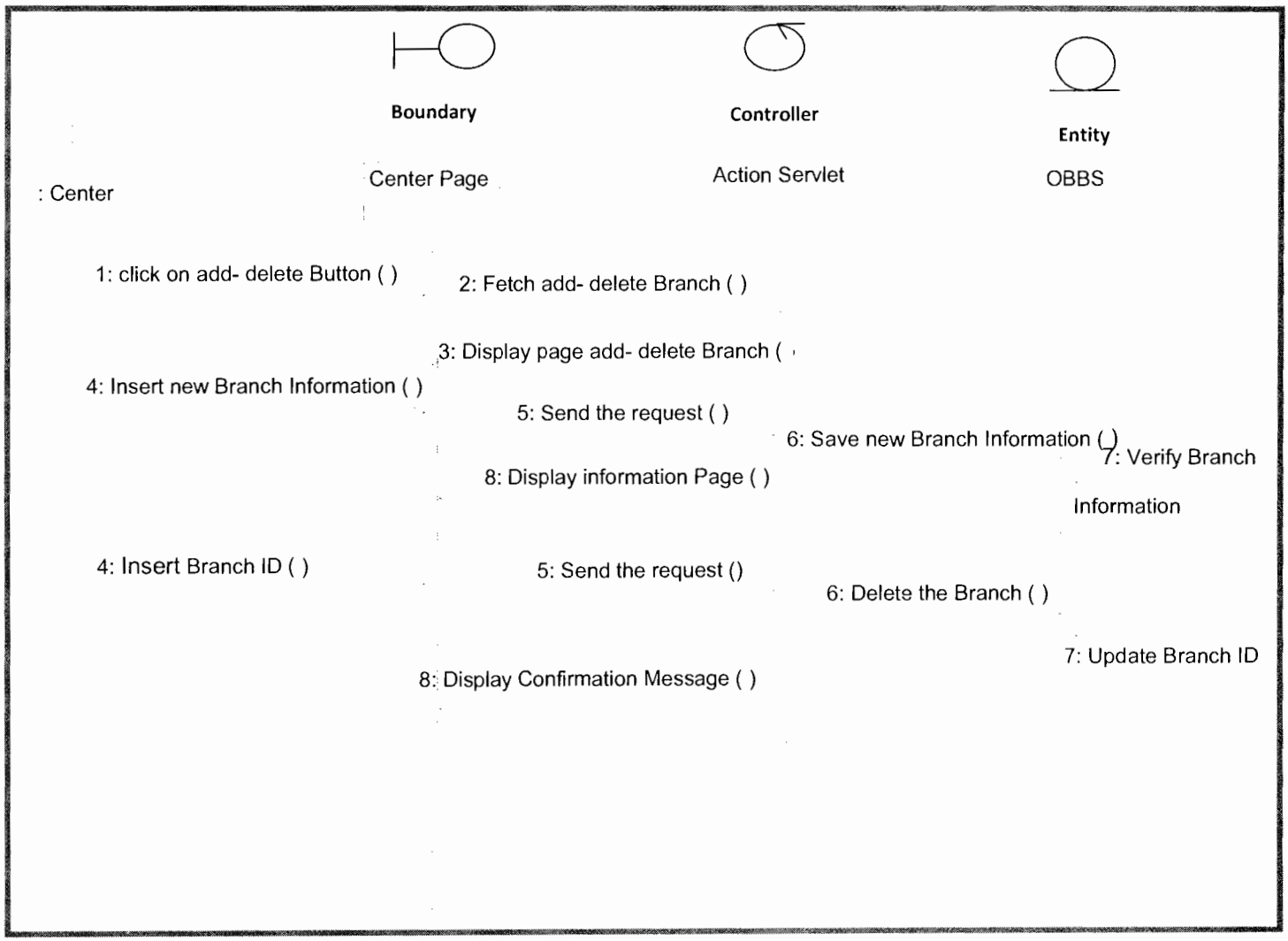


Figure 4.12: Sequence Diagram for Manage System

4.6.6 View Report

This diagram shows the sequence that has to do with the process of viewing report by the branch and or center. It shows the way the users of the system can see user's report by clicking on report button. The system will access the DB and read data, and will display the report. The branch sees all detail of blood demands in the branch. The Center sees all detail of blood demands of all branches.

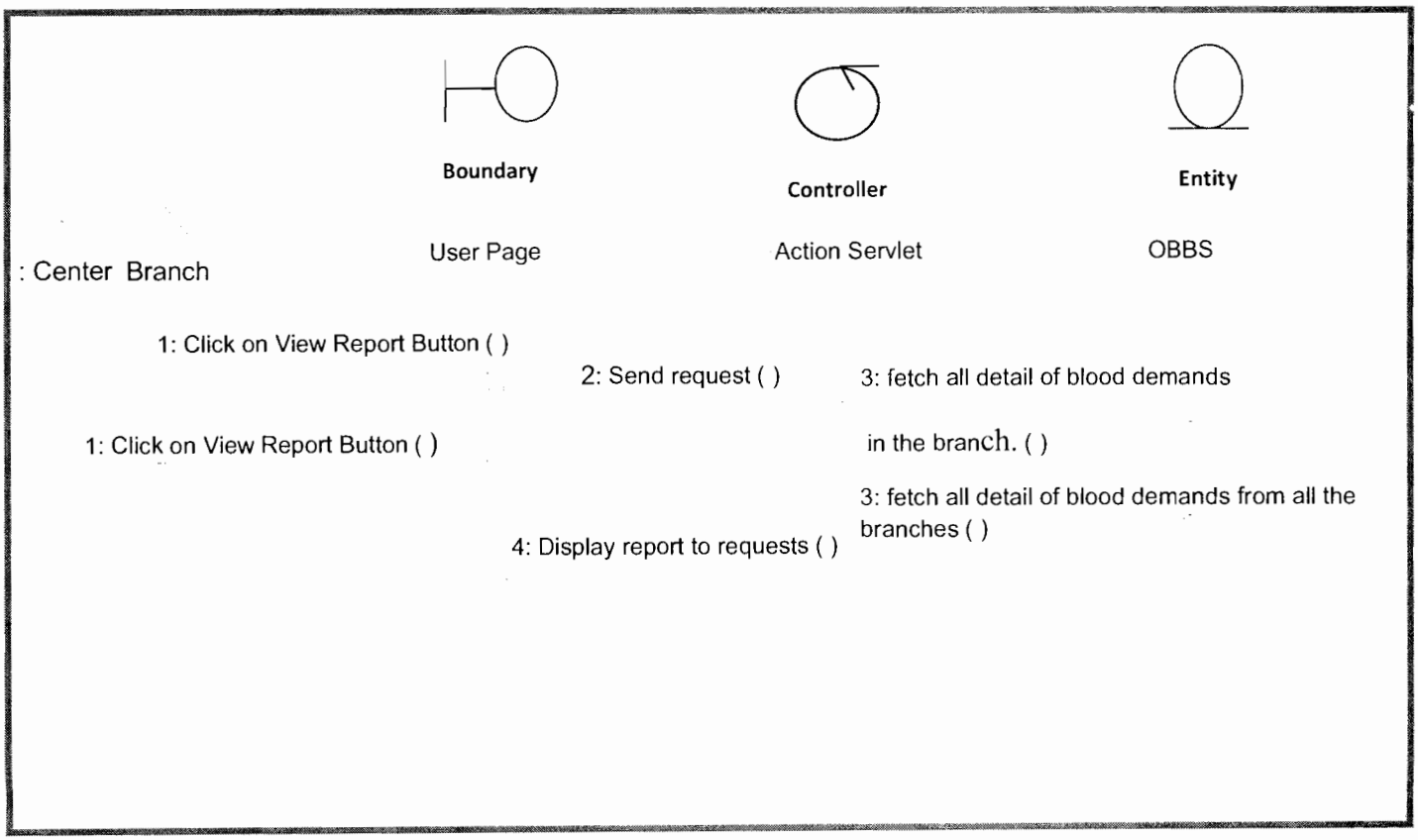


Figure 4.13: Sequence Diagram for View Report

4.7 Class Diagram

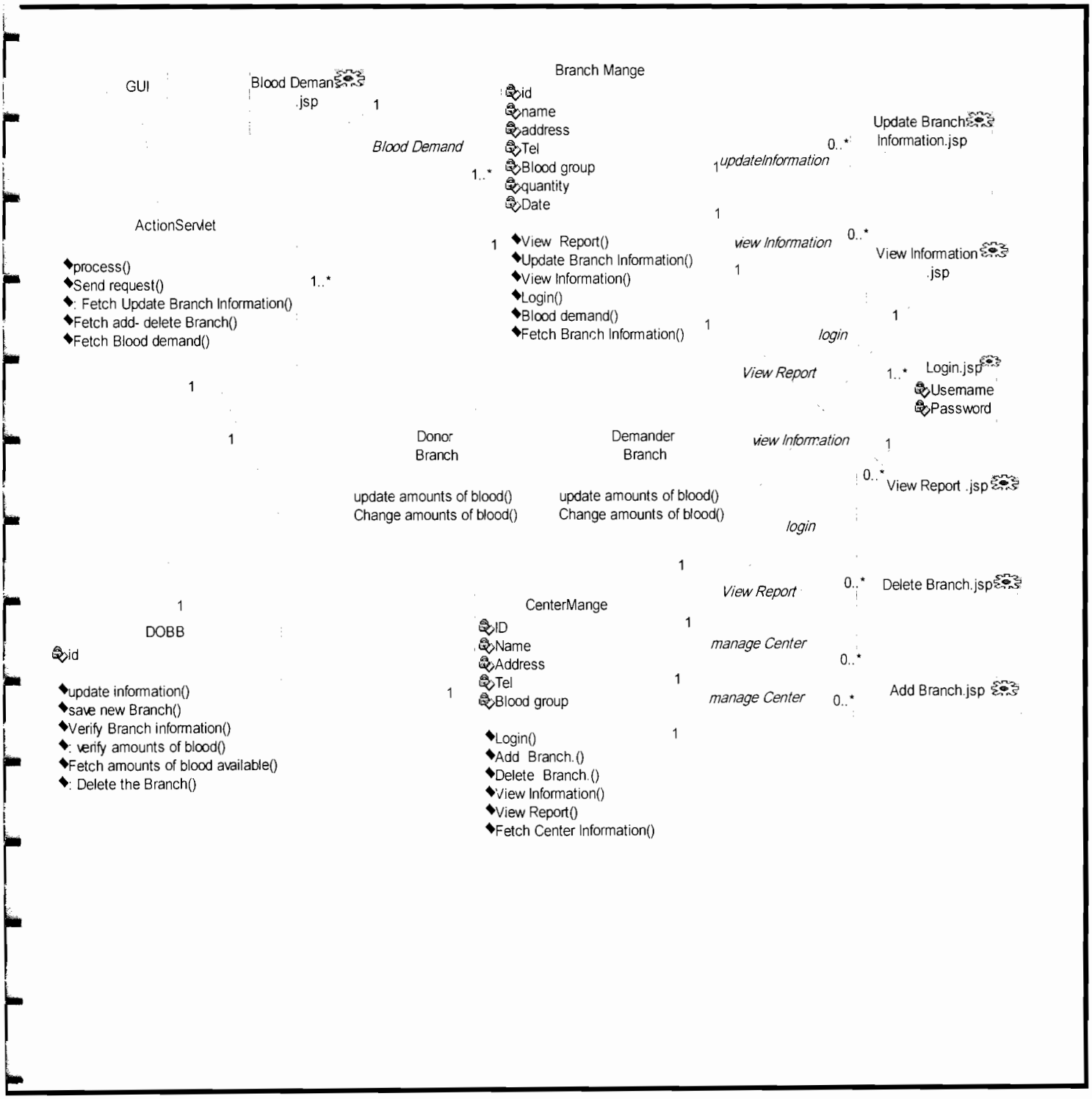


Figure 4.14: Class Diagram

4.8 System architecture

This has to do with the architecture and the components that make up the system. Figure 4.15 represents the way the Center and Branches access the blood bank server using online system.

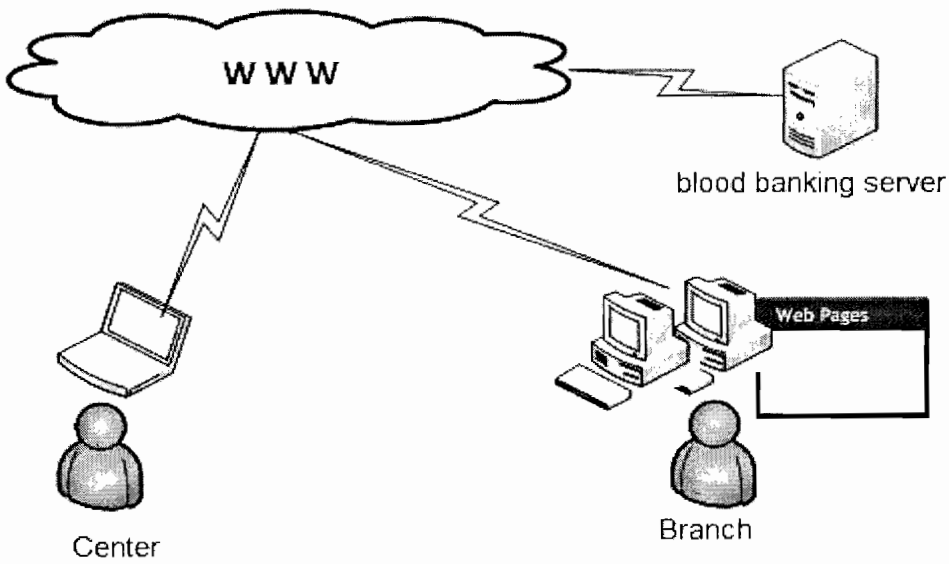


Figure 4.15: System architecture

4.9 OBBS Interface Design

4.9.1 Login Page

This page welcomes the user to the application. It displays and allows the user to input User Id and Password, then click the login button; the screen will automatically display the Home page. Based on the user login info the system will specify the user role and permissions, based on those permissions the system main menu which is a dynamic menu will be generated to enable the user to access only the authorized pages of the system as shown in Figure 4.16.

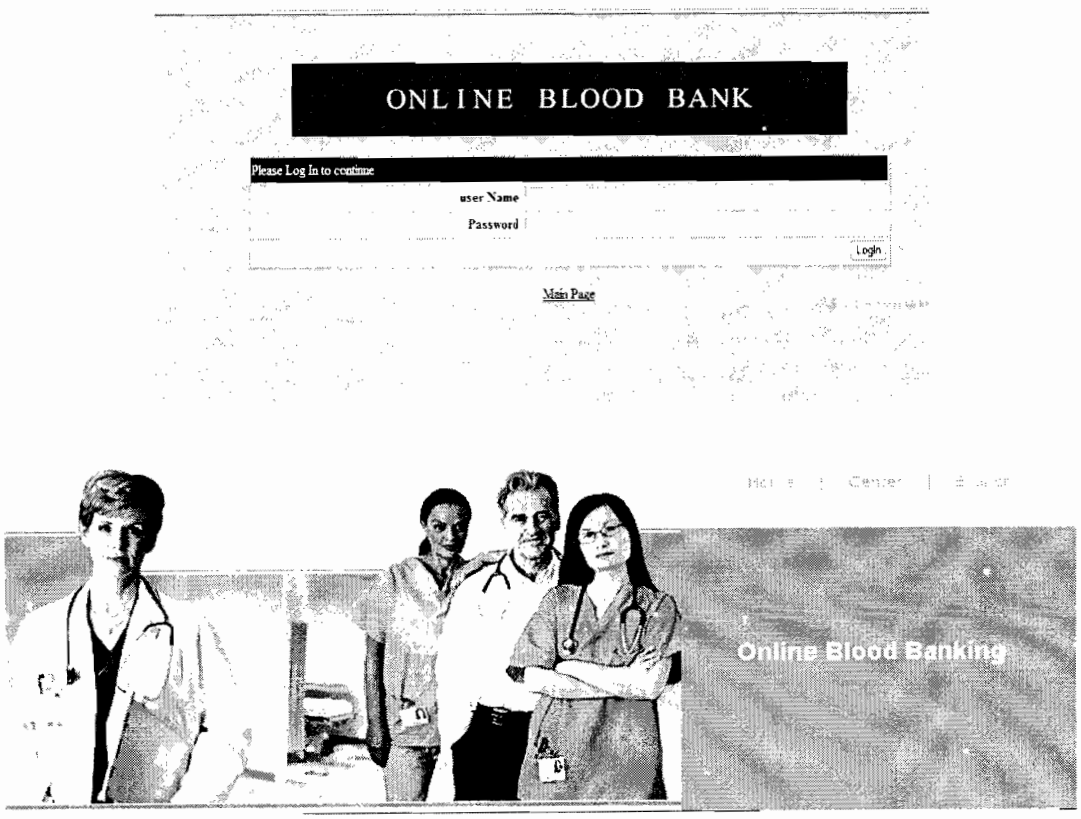


Figure 4.16: Login Page

4.9.2 Page of Add New Branch

The user of this page is the system administrator, as shown in Figure 4.17. In order to add any new Branch by the center, the Center simply selects Add button and insert the new Branch information and click on submit to store the data in the system database.

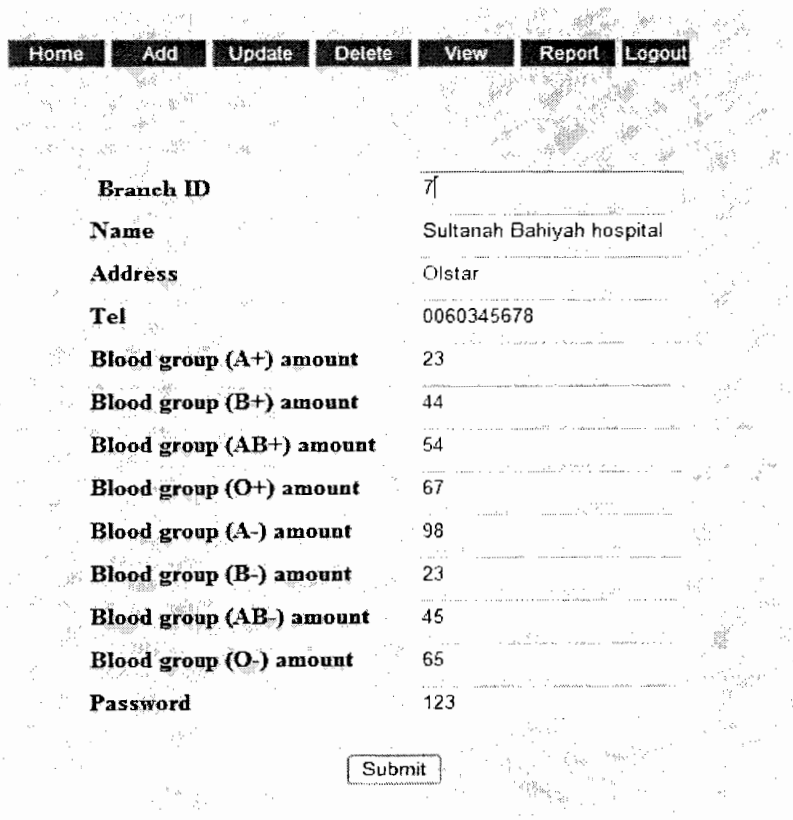


Figure 4.17: Page of Add New Branch

4.9.3 Page of Delete Branch

This page allows the Center to delete the Branch. To do this the Center must click on the delete button and insert Branch ID as shown in Figure 4.18.

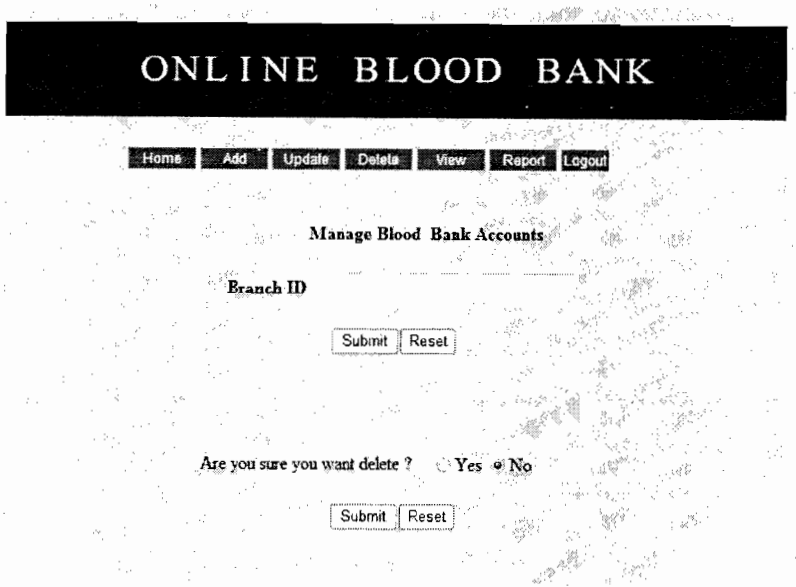


Figure 4.18: Page of Delete Branch

4.9.4 Page of Update Branch Information

This page allows the Branch to update the information as shown in Figure 4.19.

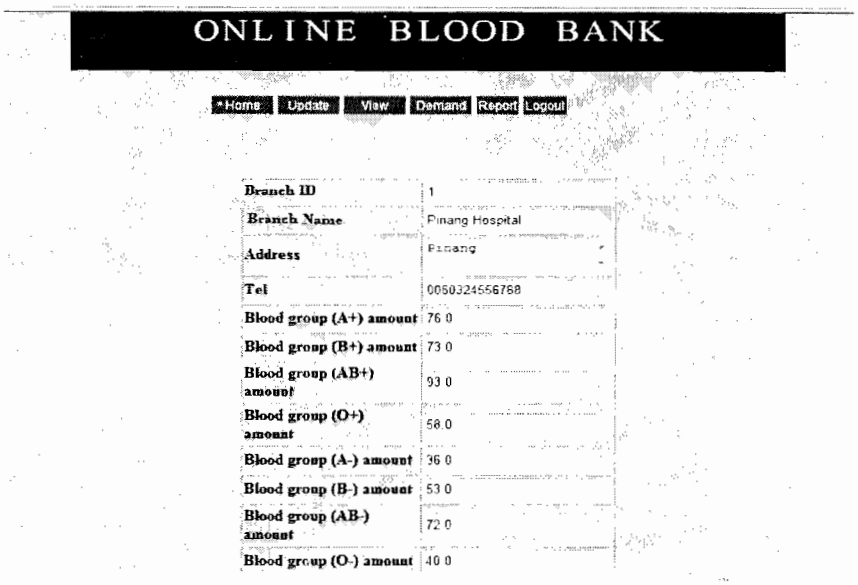


Figure 4.19: Page of Update Branch Information

4.9.5 Page of View Information

This page allows the Center and the Branch to view Branch information. When the Branch wants to view the information, the branch has to click on the view button as shown in Figure 4.20a.Whereas the Center can view information of any Branch after inserting ID Branch as shown in Figure 4.20b.

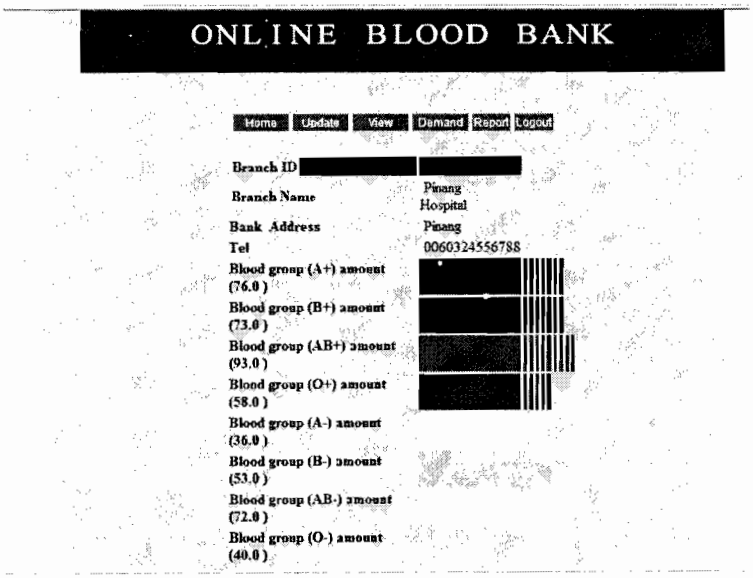


Figure 4.20a: Page of View Information Used by Branch

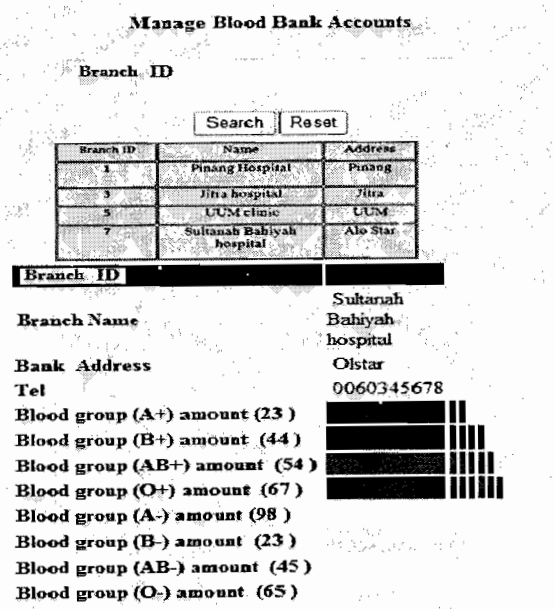


Figure 4.20b: Page of View Information Used by Center

4.9.6 Page of Blood Demand

This page allows the Branch to request the amount of blood needed by their branch. This can be done just after clicking on Demand button, inserting the amount of blood and clicking submit as shown in Figure 4.21a.

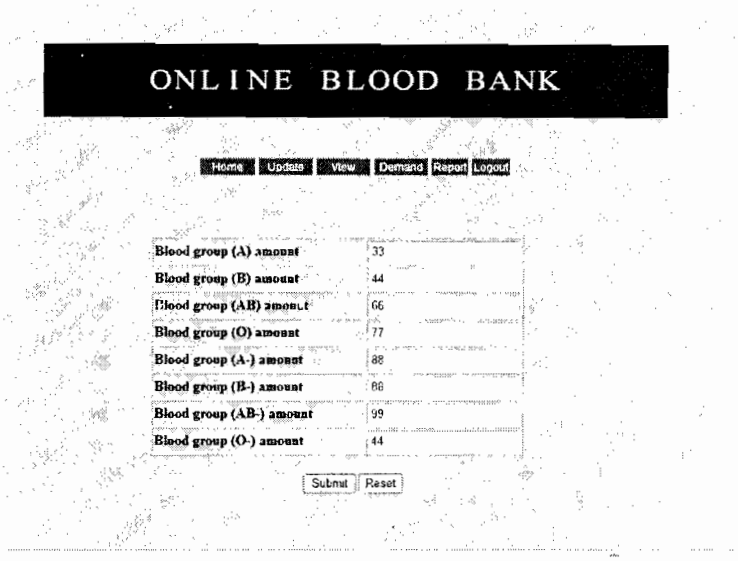


Figure 4.21a Page of Blood Demand

The system displays information about the branches that have the required amounts of blood. The Branch has to choose the suitable branch as shown in Figure 4.21b.

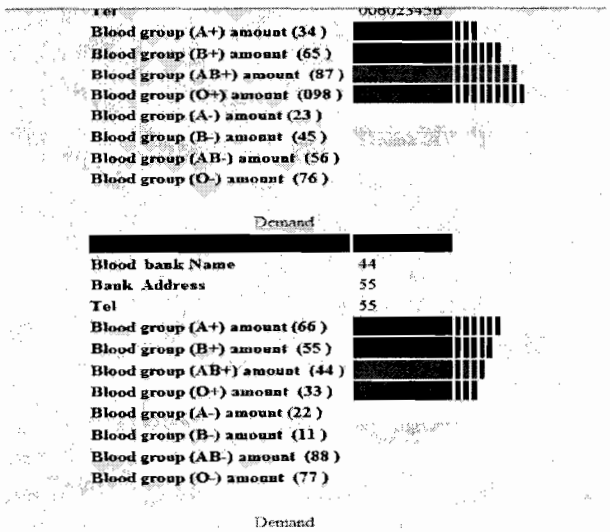


Figure 4.21b Page of Blood Demand

The system displays report about the requested amount of blood. And then the Branch can print it as shown in Figure 4.21c.

The demand has been done successfully

Print	
Date	26-04-2010
Branch ID	11
Blood Group A+	10.0
Blood Group B+	11.0
Blood Group AB+	18.0
Blood Group O+	3.0
Blood Group A-	11.0
Blood Group B-	8.0
Blood Group AB-	9.0
Blood Group O-	3.0

Figure 4.21c Page of Blood Request

4.9.6 Page of View Report

This page allows the Branch to view report about the amounts of blood that has been requested as shown in Figure 4.22a. The Center can view report about the amount of blood that had been requested from all the branches as shown in figure 4.22b.

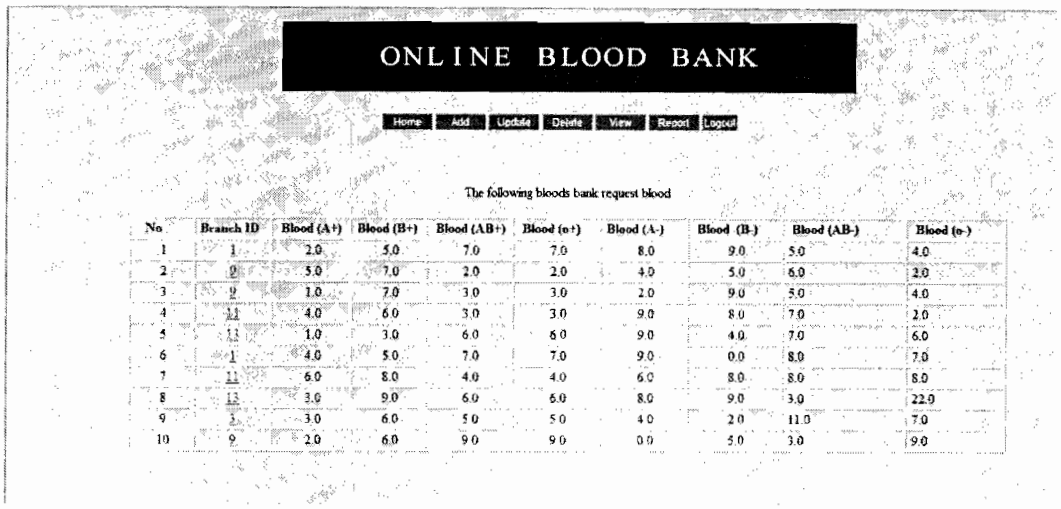
ONLINE BLOOD BANK

Home | Update | Delete | View | Demand | Report | Logout

The following bloods bank request blood

No	Branch ID	Blood (A+)	Blood (B+)	Blood (AB+)	Blood (o+)	Blood (A-)	Blood (B-)	Blood (AB-)	Blood (o-)
1	1	4.0	5.0	6.0	7.0	9.0	0.0	8.0	7.0
2	11	6.0	8.0	9.0	4.0	6.0	8.0	8.0	8.0
3	13	3.0	9.0	5.0	6.0	8.0	9.0	3.0	22.0
4	3	3.0	6.0	7.0	5.0	4.0	2.0	11.0	7.0
5	9	2.0	6.0	8.0	9.0	0.0	5.0	3.0	9.0

Figure 4.22a Page of View Report Used by Branch



No	Branch ID	Blood (A+)	Blood (B+)	Blood (AB+)	Blood (o+)	Blood (A-)	Blood (B-)	Blood (AB-)	Blood (o-)
1	1	2.0	5.0	7.0	7.0	8.0	9.0	5.0	4.0
2	9	5.0	7.0	2.0	2.0	4.0	5.0	6.0	2.0
3	9	1.0	7.0	3.0	3.0	2.0	9.0	5.0	4.0
4	11	4.0	6.0	3.0	3.0	9.0	8.0	7.0	2.0
5	11	1.0	3.0	6.0	6.0	9.0	4.0	7.0	6.0
6	1	4.0	5.0	7.0	7.0	9.0	0.0	8.0	7.0
7	11	6.0	8.0	4.0	4.0	6.0	8.0	8.0	8.0
8	12	3.0	9.0	6.0	6.0	8.0	9.0	3.0	22.0
9	2	3.0	6.0	5.0	5.0	4.0	2.0	11.0	7.0
10	9	2.0	6.0	9.0	9.0	0.0	5.0	3.0	9.0

\Figure 4.22b Page of View Report Used by Center

4.10 Summary

This chapter covers implementation of Online Blood Banking System and highlights the architecture of the system. It also covers areas which have to do with list of requirements, such as the functional and non functional requirements. It also emphasizes on areas relating to use case diagram, use case specification, sequence diagram, class diagram, and the system interface design, that have been used to describe how users interact with the system.

CHAPTER 5

RESULT DISCUSSION

5.1 Introduction

This chapter is used to expatiate on the results of the study by evaluating the OBBS. Usability test is one of the most fundamental methods in usability evaluation, because in real test users are asked to use the system. The arbitrator of the test gives predetermined test tasks one at a time to the user, who in turn performs the tasks with the user interface (Nielson, 1993). In this study the researcher selected 5 doctors to be the respondents of the questionnaires, and the questionnaires in all comprised of 14 questions that was answered by the doctors except for the negative and positive aspects included in the questionnaires.

5.2 System Evaluation

The key goal of this section is to discuss the evaluation of the OBBS. Five users were involved in this test and the researcher deem it fit and comfortable with as regards the system testing, although there is a study that argues that only four to five skilled participants will expose the majority of usability problems. The users involved in this test have broad experience and skills that will be made use of in testing the system. (Nielsen, 2000; Virzi, 1992; Spool and Schroeder, 2001).

5.3 Evaluation Techniques

The testing was conducted by monitoring user's performance on watchfully constructed standard tasks in the field, in order to collect information about the user's thoughts relating to the system.

5.4 Constraints and Purpose

Time was the primary constraint for the usability tests and data analysis. The purpose of this evaluation is to find usability problems and to improve the design of the OBBS. Usability is expressed in the form of the percentage of participants performing each task correctly without asking for assistance.

5.5 Testing and Results

The system is tested by using a sample of Jitra hospital doctors because of their familiarity with online blood banking systems. The results of the usability test are described below. The data collected through the questionnaire was analyzed using SPSS software version 14 for windows. The following figures and tables show the obtained results from the data analysis.

5.6 Reliability Analysis Test

Reliability is the extent to which an experiment, test, or any measuring procedure yields the same result on repeated trials, also reliability can be simply defined as the degree to which measures are free from error and therefore, yield consistent results (Zikmund, 2003).

There are a number of different reliability coefficients such as Split half reliability, Guttman, Parallel, Strictly parallel and Cronbach's alpha. One of the most commonly used is the Cronbach's alpha because it can be interpreted as a correlation coefficient and ranges in value from 0 to 1 (Coakes and Steed, 2003). Therefore, in this study, Cronbach's alpha was used as a measurement of reliability for each variable.

Table 5.1: Results of Reliability Test

Variables	No. of Items	Cronbach's Alpha
Usability	14	**.867**

From the analysis done on the instruments listed under each variable in the questionnaire, **Table 5.1** shows that Cronsbach's Alpha of the variable usability as **0.867**. The usability have Cronbach alpha of greater than **0.7**, thus, these measures satisfy the internal reliability criterion (Pallant, 2007).

Table 5.2 Descriptive Statistics

Items	Description	means	Scale
1	Overall, I am satisfied with how easy it is to use the OBBS.	4.20	**Agree**
2	It is simple to use the OBBS.	4.40	**Agree**
3	The OBBS can motivate the Branch to use the internet with continuance.	4.20	**Agree**
4	Through OBBS the Branch can obtain for information easily.	4.00	**Agree**
5	With OBBS Branch can get a blood amount early.	3.40	**Agree**
6	I think the Branch will be comfortable with using OBBS.	4.00	**Agree**
7	It was easy to learn to use OBBS.	3.80	**Agree**
8	OBBS is useful for the Branch.	4.60	**Strongly Agree**
9	The information provided with OBBS is clear	3.80	**Agree**
10	The information in OBBS is effective in helping blood banking to save the blood.	3.60	**Agree**
11	The interface of OBBS is pleasant	3.20	**Neutral**
12	I like using the interface of OBBS.	4.20	**Agree**
13	OBBS is flexible to interact with Branch.	3.60	**Agree**
14	Overall, I am satisfied with OBBS.	4.00	**Agree**

Now we will elaborate on the first part of the question, and this can be shown as below. We will start with (Overall, I am satisfied with how easy it is to use the OBBS.), Table 5.3 and Figure 5.1 present the frequency, the percentages and interactive Graph for the first question.

Table 5.3: Frequency Statistics for the First Question

Cumulative Percent	Valid Percent	Percent	Frequency		
20.0	20.0	20.0	1	3.00	Valid
60.0	40.0	40.0	2	4.00	
100.0	40.0	40.0	2	5.00	
	100.0	100.0	5	Total	

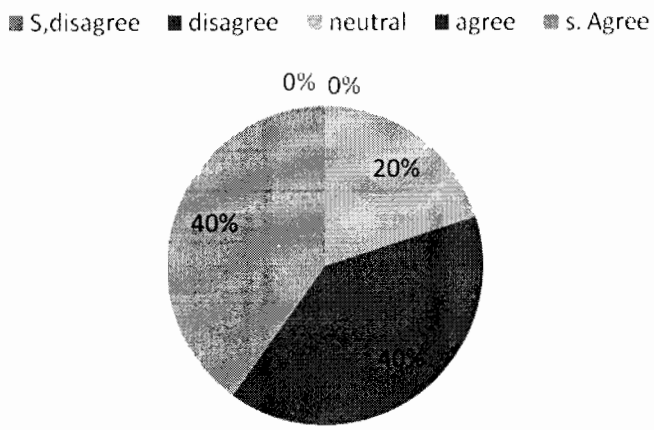


Figure 5.1: Interactive Graph for the First Question

Figure 5.1 shows the interactive Graph, where 40% answers agree, another 40% answers strongly agree, and 20% answers were on neutral for the system.

Also we will elaborate the eighth question part as bellow and we will start with (OBBS is useful for the Branch.) Table 5.4 and Figure 5.2 present the frequency, the percentages and interactive Graph for the eighth question.

Table 5.4: Frequency Statistics for the Eighth Question

Cumulative Percent	Valid Percent	Percent	Frequency		
20.0	20.0	20.0	1	3.00	Valid
100.0	80.0	80.0	4	5.00	
	100.0	100.0	5	Total	

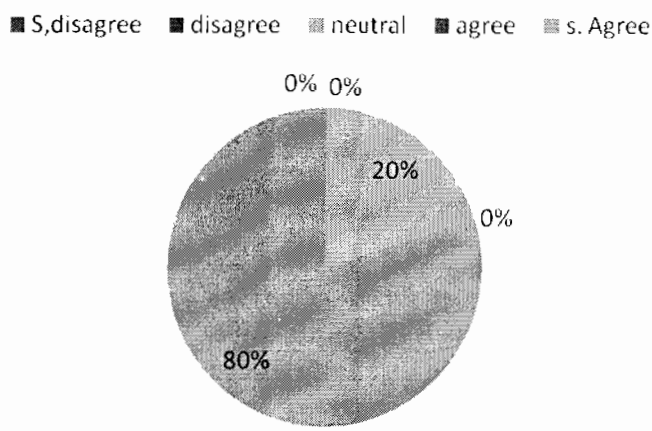


Figure 5.2: Interactive Graph for the Eighth Question

Figure 5.2 shows the interactive Graph where 80% answers agree and strongly agree, while, 20% answers were on neutral for the system.

Also we will elaborate on the eleventh question, and this can be shown as below. We will start with (The interface of OBBS is pleasant). Table 5.5 and Figure 5.3 present the frequency, the percentages and interactive Graph for the eleventh question.

Table 5.5: Frequency Statistics for the Eleventh Question

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3.00	3	60.0	60.0	60.0
	4.00	2	40.0	40.0	100.0
	Total	5	100.0	100.0	

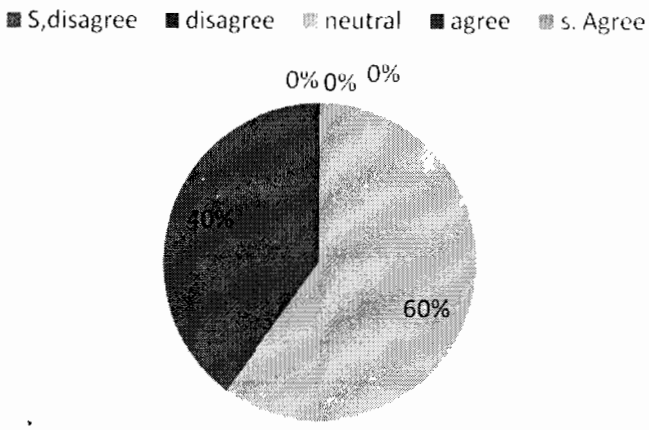


Figure 5.3: Interactive Graph for the Eighth Question

Some users preferred a simple interface without too many fancy features. But some of them thought that the interface should be more attractive and colorful. The testers felt that the available functions were sufficient and covered most important branch's needs to get the blood.

5.7 Summary

This chapter discussed the analysis of the obtained data by the questionnaire. From above, one can conclude that most of the participants agreed with the good usability of OBBS. From the testing and evaluation conducted, the prototype support the requirements needed for the branch to get blood. The prototype still needs to increase the functions to assist the branch on how to request for blood in other branches .The output of this chapter represents the result of user evaluation where all the users agreed on the system prototype.

CHAPTER 6

CONCLUSION

6.1 Introduction

This chapter reviews the development of the entire project. This includes the problems and limitations faced during the development of this project. Finally, this chapter will be concluded with potential directions for further research connected to the project.

6.2 Problems and Limitations

This project focuses on the required effort for branches to request blood using the easiest possible way, which has to do with online blood banking system most especially for countries that cannot afford the expensive systems used in requesting blood. However, some problems and limitations discovered during and prior to the development of the project are:

- The system was tested locally in but the data used to test the system was not the real data.

- The system interfaces and forms were built and tested on Microsoft Internet Explorer 7 browser, and some other recent versions. It might encounter some display problems like font size, text alignment on Netscape Navigator, or any other browsers like the recent browser Google Chrome.

- The system's database is a stand-alone database and not incorporated or integrated with any of the administrations databases that already exist and used by hospital. This may increase data redundancy or consistency related issues, and might require checking data consistency when storing any data.

- There is no integration or extraction tool between this system's database and other hospital systems databases such as the human resources departments and the labs departments. It still needs to key in some data manually like the results from blood testing.

6.3 Future Development Considerations

During the development of this system, a number of issues concerning design and development were revealed. Future design and development of related projects could be done based on these considerations:

- In the future, there will be a development in the system concerning the inclusion of information about donor

- Intelligent database system can be used to integrate the OBBS database with other similar related databases and building a data warehouse for them to be used by any system concerned in this Branch.

- Expanding this online blood banking system to be automated system without the need for any interference or sending the blood demand manually.

6.4 Conclusion

This research is aimed to develop an online blood banking system to be made use of to overcome the problem of shortage in the amounts of blood in the blood bank, and by connecting the branches of the bank through the internet to make it easier for them to share the available amounts of blood. This service is considered as a humanitarian service.

This research is aimed towards developing an online blood banking system to facilitate the operations of branches, by assisting them in terms of requesting for blood from other branches.

Further research work still need to be done in order to make the system more functional and reliable, such as information of this project as mentioned earlier. Therefore, the results from this study can be used as a basis, a stepping stone, a roadmap or a starting point for future research and studies related to this topic.

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APPENDIX A

Interview Questions

- What is the current system used by the central blood bank to request for blood?
- How does the central blood bank contact its branches?

- What kind of problems does the blood bank faces in requesting for blood?

- How does the central blood bank get information about the amount of blood in the branches?

APPENDIX B

Questionnaire

Based on: Lewis, J. R. (1995) *IBM Computer Usability Satisfaction Questionnaires: Psychometric Evaluation and Instructions for Use.* **International Journal of Human-Computer Interaction**, 7:1, 57-78.

Online Blood Banking System for blood demand

Please rate the usefulness and ease of use of **Online Blood Banking System (OBBS)**

1 = Strongly Disagree, 2 = Disagree, 3 = Natural, 4 = Agree, 5 = Strongly Agree.

Items	Description	1	2	3	4	5
1	Overall, I am satisfied with how easy it is to use the OBBS.					
2	It is simple to use the OBBS.					
3	The OBBS can motivate the Branch and the Center to use the internet with confidence.					
4	Through OBBS Branch and the Center can obtain for information easily.					
5	With OBBS Branch and the Center can get a blood amount early.					
6	I think the Branch and the Center will be comfortable with using OBBS.					

7	It is easy to learn to use OBBS.					
8	OBBS is useful for the Branch and the Center.					
9	The information provided with OBBS is clear					
10	The information in OBBS is effective in helping blood banking to save the blood.					
11	The interface of OBBS is pleasant					
12	I like using the interface of OBBS.					
13	OBBS is flexible to interact with Branch and the Center.					
14	Overall, I am satisfied with OBBS.					

List the most negative aspect(s):

1.

2.

3.

List the most positive aspect(s):

1.

2.

3.